DRAFT – 7-12-04

DOCTORAL EDUCATION IN TEXAS, PART 1: PAST TRENDS AND CRITICAL ISSUES

July 2004
Texas Higher Education Coordinating Board

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Table of Contents

Executive Summary

The purpose of this document, the first of a two-part report, is to examine doctoral education delivered at public universities and health-related institutions in Texas. The second part of the report, due in October, 2004, will provide recommendations for enhancing its effectiveness in closing the gaps in participation, success, excellence, and research. The study concerns itself strictly with "research doctorates," including the Doctor of Philosophy (PhD) degree and "applied doctorates" such as the Doctor of Education (EdD) degree. The report does not include "professional" degree programs such as Doctor of Medicine and Doctor of Pharmacy degrees.

Section I: Characteristics of Doctoral Education

The Doctor of Philosophy (PhD) degree and its equivalents represent the highest level of academic study in the nation. It is a degree that indicates (or should indicate) that a graduate has mastered the advanced concepts of a field, is able to conduct scholarly research in the discipline, and can make independent intellectual contributions to the field. Characteristics of doctoral education include:

National Market. Compared to bachelor's and master's programs, doctoral programs often address a national market. Most institutions recruit nationally and internationally for doctoral students, and graduates often leave the region, state, and country for jobs.

Length of Doctoral Programs. Traditional doctoral programs can require as few as 60 semester credit hours (past the bachelor's degree) or as many as 100 or more hours for some disciplines. Nationally, the average time to complete a doctoral degree ("enrolled time to degree") is more than seven years beyond the bachelor's degree.

Doctoral Faculty. Core faculty of doctoral programs are generally expected to engage in research activities, publish the results of that research, and serve as dissertation advisors to students. Because of these additional responsibilities, the classroom teaching load of doctoral faculty is usually less than faculty whose primarily responsibility is classroom teaching.

Student Financial Support. Many doctoral students receive a research or teaching assistantship, in which they work on faculty research projects or serve teaching functions such as leading discussion groups, supervising lab sections, or teaching courses. In addition to providing financial assistance, these positions provide students with career training and provide institutions with a source of inexpensive labor.

Section II: Demographic Trends in Doctoral Education – U.S. and Texas

Texas has mirrored the U.S. on the following trends in doctoral education:

- The number of doctoral degrees awarded in the U.S. peaked in 1998 at over 45,000 degrees, lowered, but is now rising. Texas peaked in 1996, awarding nearly 3,000 doctoral degrees.

- In 2001, U.S. and Texas institutions awarded more doctorates in science and math than in any other broad discipline. (24 and 25 percent, respectively)

- In Texas, the percent of doctoral degrees among all degrees awarded (baccalaureate and above) is close to the national average. (U.S.: 2.4 percent; Texas: 2.5 percent in 2001)

- The percent of doctoral degrees awarded to women has been increasing in the U.S. and Texas. (U.S.: from 37 percent in 1991 to 45 percent in 2001; Texas: from 36 to 44 percent)

- In 2001, significantly more females than males received doctoral degrees in the field of education in the U.S. and Texas. Significantly more males than females received doctoral degrees in the fields of science, math, and engineering.

- In the U.S. and Texas, international students receive about one-fourth of the doctoral degrees awarded. The percentage of Blacks and Hispanics receiving doctorates has risen only slightly from 1991 to 2001. (U.S.: Blacks 3 to 5 percent, Hispanics 2 to 3 percent; Texas: Blacks 3 to 4 percent, Hispanics 3 to 5 percent)

- In the U.S. and Texas, Blacks and Hispanics are proportionally underrepresented in doctoral education in relationship to their numbers in the population. (U.S: Blacks 12 percent in population versus 6 percent of doctoral degrees, Hispanics 13 versus 4 percent; Texas: Blacks 11 versus 5 percent, Hispanics 34 versus 7 percent in 2001 for non-international students)

- In 2001, doctoral degrees awarded to Blacks and Hispanics were concentrated in the field of education in the U.S. and especially in Texas. The percent of Hispanics and particularly Blacks receiving doctorates in the fields of science and math were lower than the percent of other groups receiving doctorates in these fields.

<u>Texas differs from the U.S. on the following trends:</u>

- In 2001, 85 percent of doctoral degrees awarded in Texas were from public institutions, as compared to the national average of 63 percent.

- In 2001, Texas awarded fewer doctoral degrees per 100,000 population than the U.S. average. (13 and 16 per 100,000 respectively)

<u>Some facts and trends in doctoral education in Texas by region are as follows:</u>

- In 2003, The University of Texas at Austin and Texas A&M University, both in Central Texas, account for more than one-half of the doctoral degrees awarded in the state.

- In 2003, doctoral degrees awarded per 100,000 population were the highest in Central Texas and the lowest in South Texas (of the regions producing doctoral degrees).

- The Central Texas and the Metroplex regions offer more doctoral programs than other regions of the state. Those regions and the Gulf Coast and South Texas regions have added more doctoral programs in the last ten years than other regions in the state.

Section III: Critical Issues Concerning Doctoral Education

Concerns and criticisms about doctoral education in Texas and the U.S. are numerous and significant.

Quality of Programs. National rankings of doctoral programs by *U.S News and World* and the National Research Council, among others, suggest that the quality of such programs can be measured somewhat precisely and then reflected in a rank-order list. However, many in the academic community question the validity of these rankings. One criticism of the rankings is that they rely, in part, on "reputational data" in which faculty peers (and administrators) provide quality judgments of other programs in their respective disciplines.

There are many quantifiable quality indicators of doctoral programs, such as number of faculty publications and grants per year, the percent of students who are full-time, graduation rates, time-to-degree of students, placement of graduates etc. Despite the availability of these quantitative indicators of quality, there is no definitive or singular methodology to evaluate doctoral programs. However, judging the quality and effectiveness of these programs remains an important responsibility. These judgments, even if imprecise, provide necessary information to policy makers and others in the state.

Differentiated Missions and Doctoral Education. Determining which institutions should have doctoral programs and in which disciplines is a challenge for Texas and other states. California addresses this issue through its Master Plan for Higher Education. Adopted in 1960, the plan assigns each of three public segments of higher education its own distinctive mission. The nine University of California (UC) campuses are the state's primary academic research institutions, while the 23 California State University (CSU) campuses provide education through the master's degree. The UC campuses have exclusive authority for doctoral education with some limited exceptions in which CSU institutions can offer joint doctoral programs with other UC or independent institutions. While not without criticism, the California Master Plan has been praised as a rational, coherent system that encourages different types of institutions to reach excellence within their own particular mission.

Without such a clean differentiation of institutional functions for Texas public higher education, individual institutions (and their board of regents) in the state have more "mission autonomy" and opportunities for change. While this flexibility can be a positive characteristic of a higher education system, a coordinated statewide vision is advisable to guide growth in the number of new degree programs, especially doctoral programs.

Growth of doctoral programs is sometimes measured under the rubric of the Carnegie Classification system, which groups higher education institutions together, based on "institutional functions" as indicated by level of degrees awarded and the number of disciplines in which they are awarded. Carnegie has two classifications for doctoral-granting institutions, and Texas has six institutions in each of the two categories. As Texas institutions add doctoral programs (and there have been significant increases in new doctoral programs in the last two years), their Carnegie classification could change; however, the Carnegie Foundation believes that institutional growth and change just for the sake of Carnegie mobility is not a commendable educational goal.

Attrition and Time-to-Degree. Two common criticisms of doctoral programs are that not enough students finish them and those that do finish take too long. Nationwide, attrition rates of doctoral programs appear to be 40 to 50 percent. Most studies suggest that students leave not so much for academic reasons but because of either financial reasons or a lack of significant involvement in the department or program. Students holding either research or teaching assistantships are advantaged, as these positions help to address both issues. Given the significant financial investment by institutions, by states, and by the U.S. government in doctoral education and the considerable personal investment by students, all parties must increase efforts to improve the completion rates of doctoral students.

The national median "registered time-to-degree" (the total time a student is enrolled in a doctoral program from after completion of a baccalaureate degree to the receipt of the doctoral degree) was 7.6 years in 2002. This figure has been steadily rising over the last 30 years. Some factors affecting time-to-degree include adequate financial support, effective faculty mentoring, percent of part-time students, and the actual degree requirements. Institutional desires to ensure both breadth and depth of disciplinary competence for students result in additional hours in the curriculum. Higher education officials should continually evaluate doctoral degree requirements to balance their benefits against maintaining a reasonable time-to-degree for students.

Specialization of Doctoral Education: Depth versus Breadth. The struggle between depth and breadth in doctoral education is an important one. Curricular and research depth bring potential benefits to the students who can become and claim to be experts in a particular area. However, potential employers in industry, government, and even academia also want graduates with "transportable skills" that can be applied in varied circumstances. Such workforce requirements call for a broader curricular approach to doctoral education and for more opportunities for doctoral students to work collaboratively with others in and out of their field.

Diversity in Doctoral Education. Many concerns have been raised that the high participation of international students in doctoral education crowds out American students and makes it more difficult for U.S. graduates to get jobs. However, many suggest that efforts to limit the presence of international students in U.S. doctoral education are unwarranted. Some of the strongest students in doctoral programs in the U.S. are international students, who therefore enhance the intellectual (and cultural) climate of doctoral programs. In addition, the international students that stay in the U.S. after graduation are assets to their employer, and those that leave the U.S strengthen the workforce of their native countries. These students can also take back with them a better understanding of U.S. culture.

The concern about the under-representation of Black and Hispanic students is a valid one. Because of the under-representation of these groups in doctoral education, they are also underrepresented in fields that require doctoral degrees, such as in academia. The nation's universities have a major responsibility to work with both K-12 and undergraduate institutions to encourage Black and Hispanic students to prepare for and complete doctoral education in a broad variety of fields – especially science, math, and engineering.

Workforce Needs. Surveys show that less than half of doctoral graduates eventually work as tenure-track faculty at universities and health-related institutions. Employment opportunities and student interest in these positions vary considerably by discipline, but since interest in faculty jobs exceed available positions in nearly all disciplines, one can conclude that supply exceeds demand with respect to academia. (Nursing is a notable exception.) Some

doctoral graduates who do not receive tenure-track positions accept non-tenure positions, but these positions are generally not as desirable for those seeking full-time permanent work.

Hopes for an increased demand for faculty positions rest in large part on expectations of significant faculty retirements in the next few years. Nearly a third of the full-time faculty in the U.S. are 55 years of age or older, but it is difficult to predict precisely the retirement patterns of these faculty. Even with a substantial amount of faculty turnover, cost constraints could continue to affect the number of tenure-track positions in higher education. There are, however, attractive career choices for doctoral graduates in business, government, health-related facilities, and non-profit organizations. Many higher education stakeholders feel that universities and health-related institutions should promote non-academic positions as having an equal status as faculty positions and should devise doctoral programs that prepare students equally for careers inside and outside of academia.

Regional Needs versus State and National Needs. Doctoral education inherently has much more of a national scope than most baccalaureate and master's programs. The job market for doctorally-trained graduates can be limited, and applicants must often extend job searches well beyond a particular region to obtain employment. This is particularly true for jobs in academia; as a general rule, institutions do not hire their own graduates for tenure-track faculty positions. While governmental agencies and businesses hire doctoral graduates from local universities, there are a limited number of positions that demand doctoral-level expertise.

Institutions must also look outside the region when recruiting doctoral students, as the local student pool can diminish over time. Most in academia agree that it is healthy and desirable that doctoral programs have a national and international focus. Universities and health-related institutions generally do not hire their own doctoral graduates, so that new faculty from different educational environments bring different ideas and fresh perspectives to apply to their respective disciplines. It is also desirable to draw students into doctoral programs from different undergraduate universities, from different parts of the state and nation, and from different countries. Such diversity enriches the doctoral experience for all.

Texas follows those patterns, as just 47 percent of the doctoral enrollment at the state's public universities and health-related institutions (in fall of 2003) were Texas residents compared to 93 percent in baccalaureate education. Texas institutions also draw most of their faculty from outside the state, as only 26 percent of doctorally prepared faculty at Texas institutions received their degrees from Texas public universities and health-related institutions. The University of Texas at Austin and Texas A&M University together produced over half of these faculty.

Section IV: Costs and Benefits of Doctoral Education

Doctoral education is expensive, with costs to students, institutions, and state that exceed baccalaureate- and master's-level education. Nationally, doctoral graduates take an average of 7.6 years (beyond a bachelor's degree) to complete their doctorates. In Texas, if no financial aid or tuition benefits were provided, that would result in an average of $20,500 for tuition and fees. Living costs and foregone wages add to the picture.

New doctoral programs are expensive for institutions and for the state. Texas programs started within the last *five* years had new five-year costs of over $2 million on average, with those in science and engineering programs costing up to $6 million. At the state level, doctoral students account for 2.1 percent of the total semester credit hours generated, but they garner for their institutions 12.4 percent of all formula-driven instruction and operation funds. Doctoral education has disproportionately higher costs (and formula income) because of expensive equipment, laboratories, and library resources; higher faculty to student ratios; and higher faculty salaries. This translates into average costs of $44,019 per doctoral full-time student-equivalent (FTSE) versus $18,024 for a master's FTSE or $8,430 for bachelor's FTSE.

Yet, doctoral education yields many benefits. For the graduate, higher salaries and lifetime earnings, less risk of unemployment, and greater opportunities for rewarding, intellectually challenging work. For institutions, greater likelihood of generating external research funding, enhanced abilities to attract research-focused faculty, enhanced intellectual resources and opportunities, and perceived prestige. For the state and society, economic leveraging of the research funds that come into the state (over $1.2 billion in 2003); the cultural, scientific, health, and economic advances that emerge from doctoral faculty and their students; and the preparation of faculty that will educate future generations in our schools, colleges and universities.

DRAFT – 7-12-04
Doctoral Education in Texas, Part 1: Past Trends and Critical Issues

Introduction

Doctoral students account for only 1.8 percent (18,325 students) of all students in public higher education in Texas, yet these students generate 7.4 percent ($201,209,000) of all formula funding provided by the state (in 2003). As a product of that investment, doctoral education addresses critical needs for Texas and the nation. Science and engineering graduates make significant advanced research and development contributions for industry, government, universities, and health-related institutions. Graduates in humanities, social sciences, and the arts enhance our understanding of human thought and the human condition. And graduates in every discipline serve as faculty in all sectors of higher education.

The purpose of this document, the first of a two-part report, is to examine doctoral education delivered at public universities and health-related institutions in Texas. Section I of the report describes the characteristics of doctoral education and distinguishes it from other kinds of post-baccalaureate degree programs. Section II reviews past trends in doctoral education in Texas and the U.S. and includes demographic data on degree production and other measures. Section III examines critical issues and concerns about doctoral education, including program quality, institutional aspirations for doctoral programs, lack of diversity of doctoral students, workforce needs, and overproduction of graduates. This first part of the report concludes with Section IV, which identifies some of the costs and benefits of doctoral education to the state, to institutions, and to students.

The second part of this study, which will be presented at the October 2004 Board meeting, will examine the strengths and concerns of doctoral education specific to Texas and will provide recommendations for enhancing its effectiveness in closing the gaps in participation, success, excellence, and research.

Section I: Characteristics of Doctoral Education

The Doctor of Philosophy (PhD) degree and its equivalents represent the highest level of academic study in the nation. It is a degree that indicates (or should indicate) that a graduate has mastered the advanced concepts of a field, is able to conduct scholarly research in the discipline, and can make independent intellectual contributions to the field.

Requirements of Doctoral Programs. While requirements for doctoral students vary considerably from institution to institution and discipline to discipline, there are some basic components of doctoral education that are common to most all programs. Doctoral students are required to:

1. complete a significant amount of graduate coursework;
2. pass "comprehensive" or "qualifying" exams which certify the student's knowledge of "core" competencies and his or her ability to continue doctoral work;
3. develop a specific area of interest within the discipline; and
4. complete a dissertation under the supervision of a faculty advisor in which the student:
    a. designs and conducts original research;
    b. writes the results of the research; and
    c. presents ("defends") the study before his or her dissertation committee.

This model for doctoral study has largely endured for the 100-year history of doctoral education in the U.S.

Distinctions from other Post-Baccalaureate Degrees. This report concerns itself strictly with "non-professional" doctorates. Professional degree programs, such as Doctor of Medicine, Doctor of Jurisprudence (law), Doctor of Pharmacy, and others provide training needed for the practice of these professions; they are not included in this study. Master's programs, while sharing some characteristics of doctoral study, are also largely "practitioner" oriented and do not represent the scholarship and research level or focus of a doctoral degree.

Applied Doctorates. The PhD is, by far, the most common doctoral degree awarded in the U.S. and Texas. However, other doctoral degrees are awarded, primarily in applied fields such as education (Doctor of Education or EdD degree). Like the PhD, these "applied" doctorates are research degrees with requirements largely similar to PhD programs. The research activities of these programs are generally in practitioner settings and are often designed to solve specific problems. Further, the dissertation studies of students in applied doctoral programs may not rise to the same threshold of "creating new knowledge" as PhD dissertations are supposed to do. However, these programs *are* research doctorates, and the National Science Foundation recognizes these degrees as equivalent to the PhD. Applied doctorates are, therefore, included in this study. At Texas public higher education institutions, applied doctorates are offered in education (EdD), engineering (Doctor of Engineering or DENG), music (Doctor of Musical Arts or DMA), public health (Doctor of Public Health or DrPH), nursing (Doctor of Science in Nursing or DSN), and physical therapy (Doctor of Science in Physical Therapy or DScPT).

National Market. Compared to bachelor's and master's programs, doctoral programs often address a national market. Most institutions recruit nationally and internationally for doctoral students, and graduates often leave the region, state, and country for jobs. (See Section III G)

Entry and Length of Doctoral Programs. Some doctoral programs require a student to have an earned master's degree in a specified discipline to enter the program; other programs allow a student to enter after the completion of a bachelor's, master's, or professional degree. Traditional doctoral programs can require as few as 60 semester credit hours (past the bachelor's degree) or as many as 100 or more hours, particularly for programs such as Clinical Psychology which include many hours of clinical work. Nationally, the average time to complete a doctoral degree ("enrolled time to degree") is more than seven years beyond the bachelor's degree. (See Section III C)

Doctoral Faculty. Core faculty of doctoral programs are generally expected to engage in research activities (which bring external funding to the institution), publish the results of that research in peer-reviewed journals or monographs, and serve as dissertation advisors to students. Because of these additional responsibilities, the classroom teaching load of doctoral faculty is usually less than faculty whose primarily responsibility is classroom teaching.

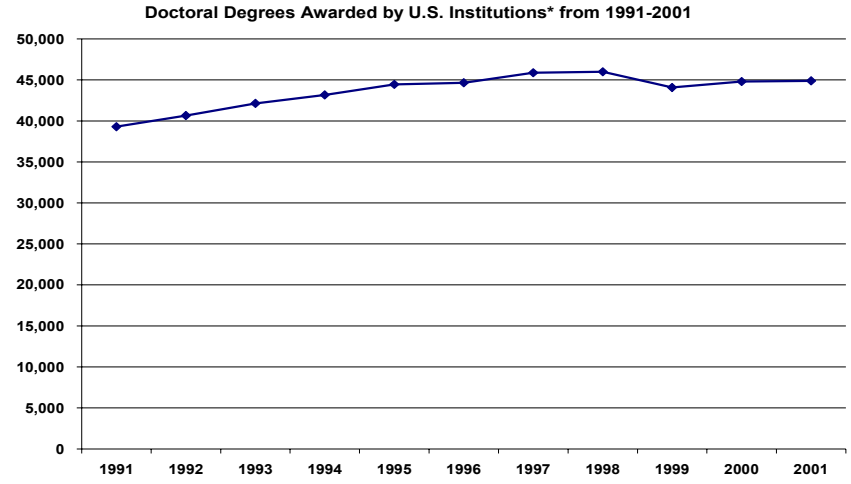
Student Financial Support. Almost all institutions provide financial support for some of their doctoral students. Nationally, approximately half of all doctoral students receive a research or teaching assistantship, in which they work on faculty research projects or serve teaching functions such as leading discussion groups, supervising lab sections, or teaching courses. In addition to providing financial assistance, these positions (usually 20 hours per week) provide students with career training and provide institutions with a source of inexpensive labor (See Section III C and Section IV).

These are some characteristics of doctoral education that distinguish it from other types of degree programs in higher education.

Section II: Demographic Trends in Doctoral Education – U.S. and Texas

A. Degrees Awarded

The number of doctoral degrees awarded in the U.S. peaked in 1998, but is rising again.



***Public and independent (private) institutions recognized and surveyed by the U.S. Department of Education's National Center for Education Statistics**

Source: U.S. Dept. of Education, National Center for Educational Statistics, Integrated Postsecondary Education Data System (IPEDS), "Completions" surveys as reported on the National Science Foundation's (NSF) WebCASPAR system.

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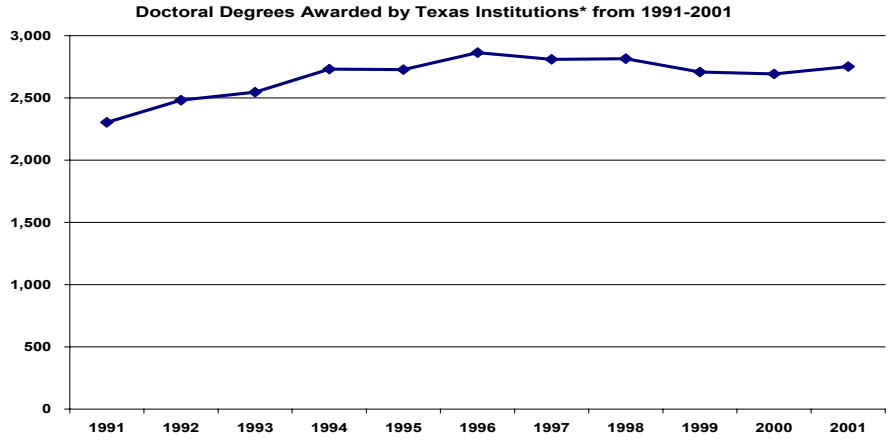
Doctoral degrees awarded in Texas largely follow the national trend, but the number peaked in 1996.



***Public and independent (private) institutions recognized and surveyed by the U.S. Department of Education's National Center for Education Statistics**

Source: U.S. Dept. of Education, National Center for Educational Statistics, Integrated Postsecondary Education Data System (IPEDS), "Completions" surveys as reported on the National Science Foundation's (NSF) WebCASPAR system.
1999 data from DOE's Digest of Education Statistics.

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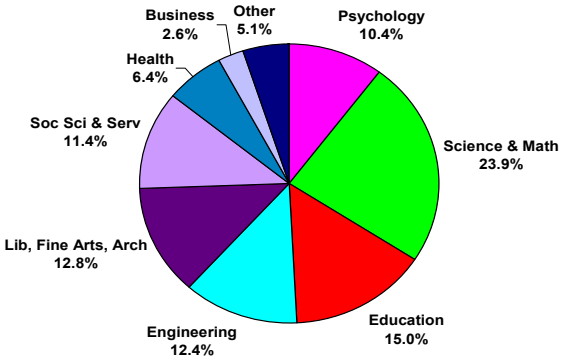
B. Degrees by Discipline

The distribution of doctorates awarded by discipline in the U.S. and Texas is very similar. Institutions awarded more science and math doctorates than any other discipline. (Note that several of the following charts rely on 2001 data – the latest available. Staff believes that data for the years shortly preceeding and following 2001 would be similar.)

Doctoral Degrees Awarded by U.S. Institutions by Discipline, 2001

Total Number of Doctoral Degrees: 44,904



Source: U.S. Dept. of Education, National Center for Educational Statistics, Integrated Postsecondary Education Data System (IPEDS), "Completions" surveys as reported on the National Science Foundation's (NSF) WebCASPAR system.

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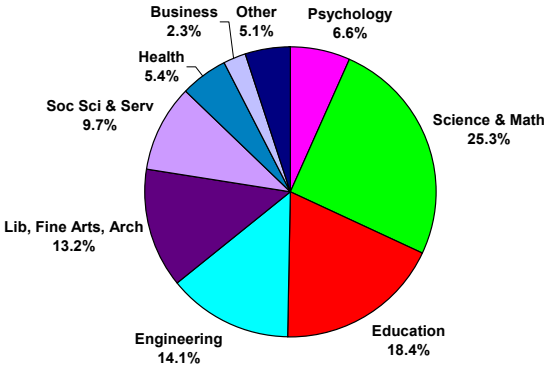
Doctoral Degrees Awarded by Texas Public & Independent Institutions (Universities and Health-Related Institutions) by Discipline, 2001
Total Number of Doctoral Degrees: 2,752



Source: IPEDS on NSF's WebCASPAR

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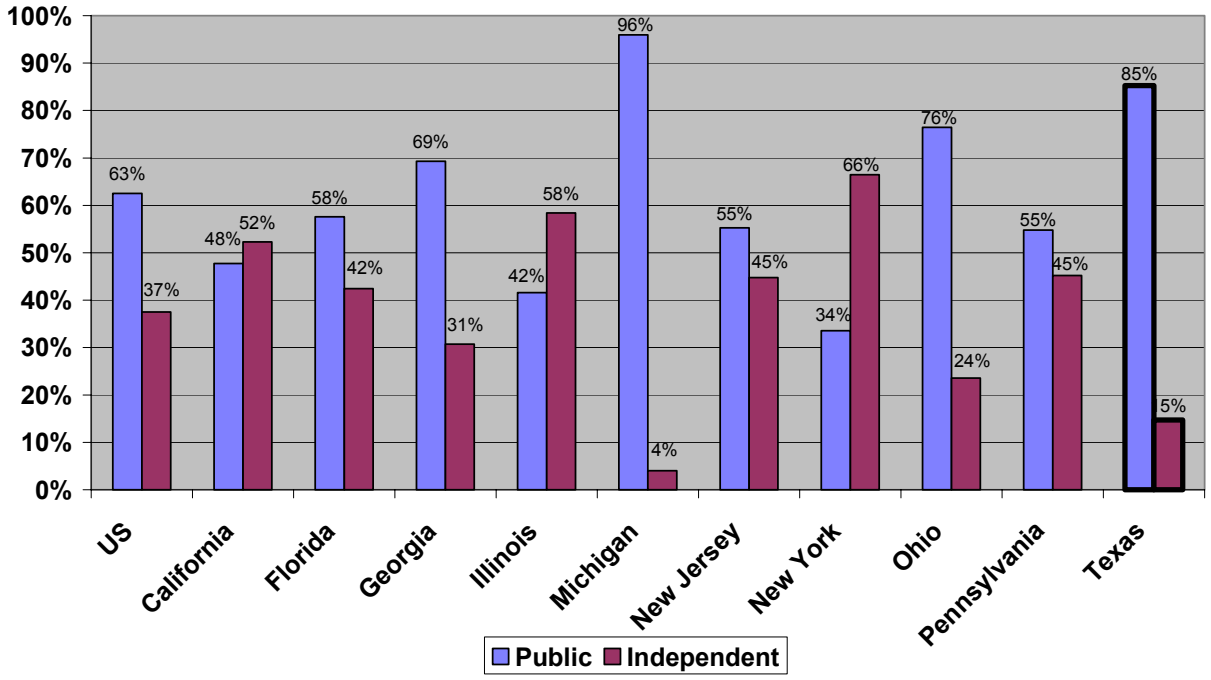
C. Degrees by Type of Institution (Public vs. Independent)

Texas ranks second, after Michigan, in the percentage of doctoral degrees awarded by public institutions (as compared to those awarded by independent institutions) among the 10 most populous states.

Doctoral Degrees Awarded by Type of Institution (Public/Independent) in U.S. and Ten Most Populous States in 2001



Source: IPEDS on NSF's WebCASPAR

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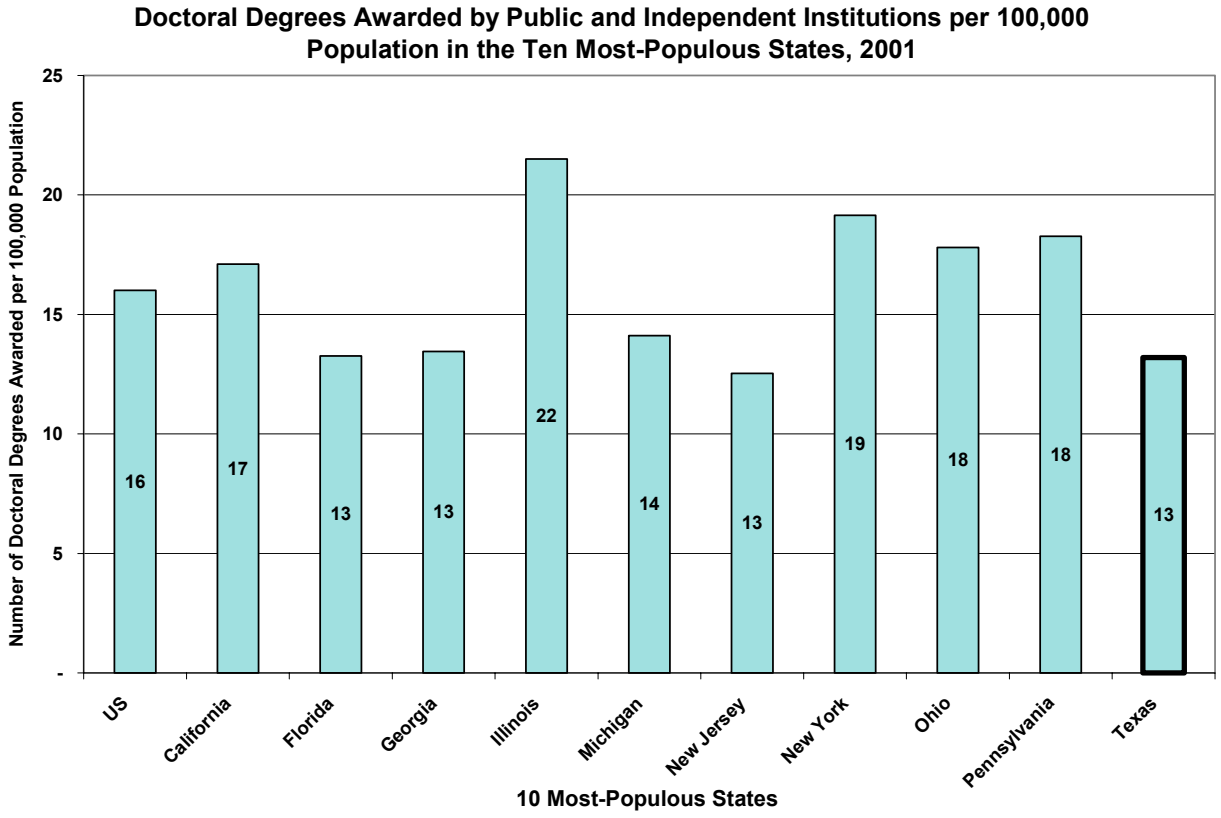
D. Degrees per Population

Texas awards fewer doctoral degrees per 100,000 population than the U.S. average and most of the 10 most populous states.



Sources: US DOE: IPEDS fon NSF's WebCASPAR, US Census Bureau

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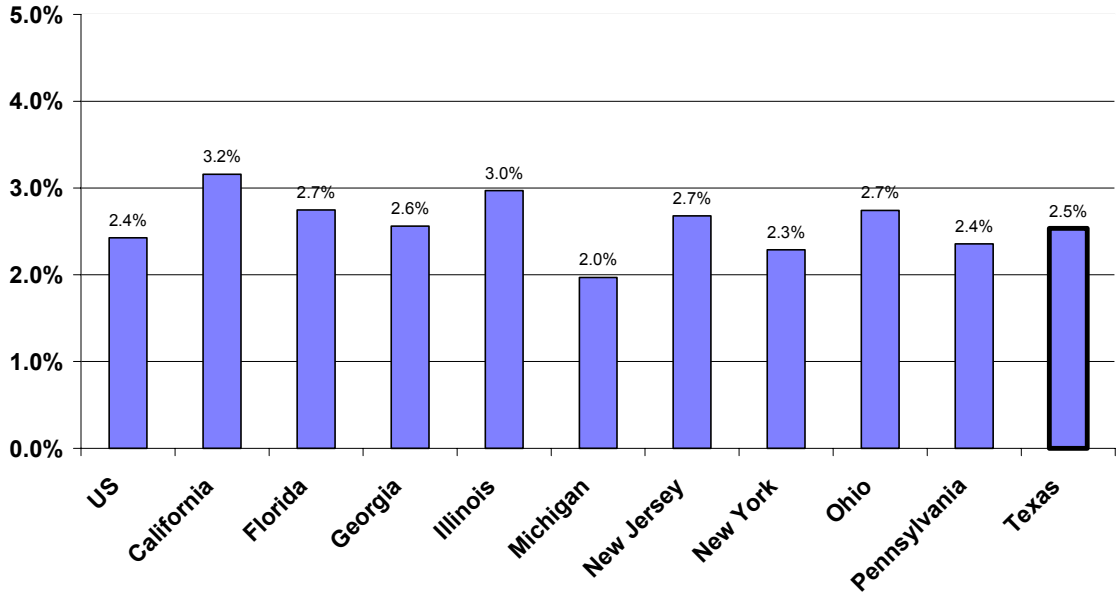
E. Percent of Doctorates Awarded

In Texas, the proportion of doctoral degrees among all degrees awarded (baccalaureate and above) is close to the national average and to many of the 10 most populous states.

Doctoral Degrees Awarded as a Percentage of Total Degrees Awarded* at Public and Independent Institutions in US and Ten Most Populous States, 2001



*Total degrees awarded at the baccalaureate through first professional levels

Source: US DOE: IPEDS on NSF WebCASPAR

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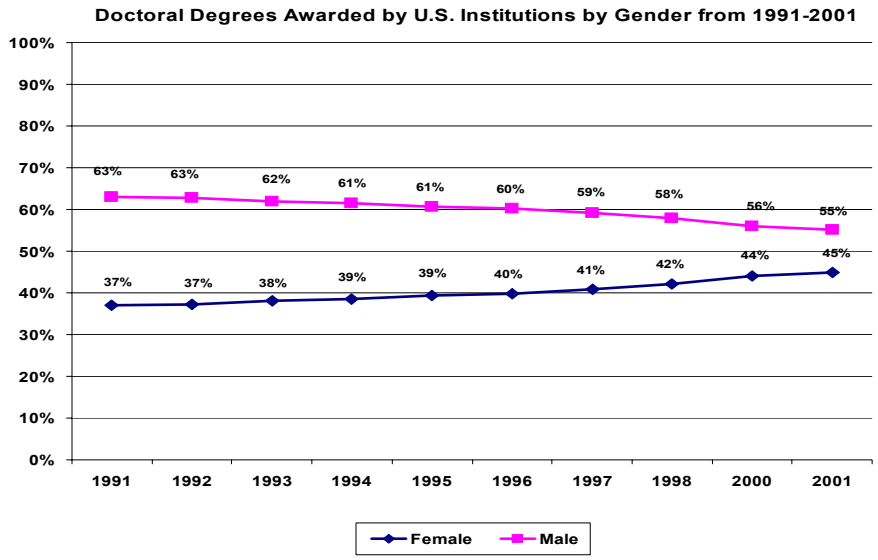
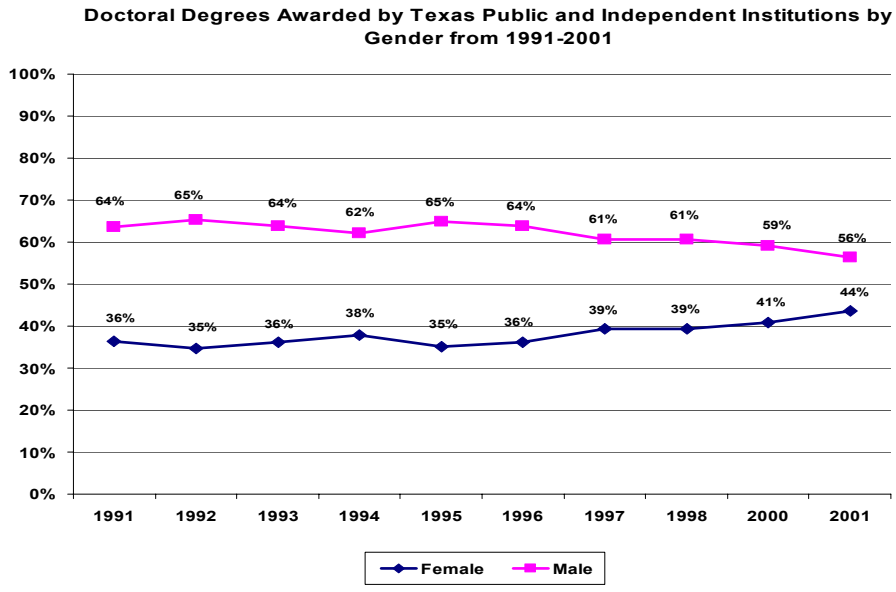
F. Degrees by Gender

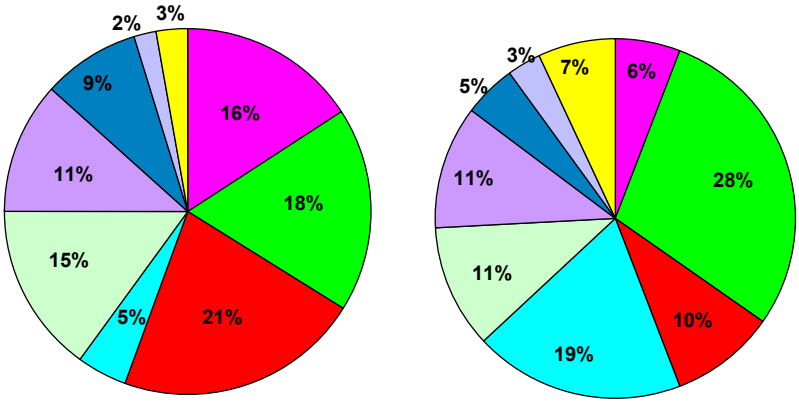
The percent of doctoral degrees awarded to women has been increasing in the U.S. and Texas.





Significantly more females than males receive doctoral degrees in the field of education in the U.S. and Texas. Significantly more males than females receive doctoral degrees in the fields of science, math, and engineering in the U.S. and Texas.

Doctoral Degrees Awarded by U.S. Institutions by Gender and Discipline in 2001: 44,904 Degrees

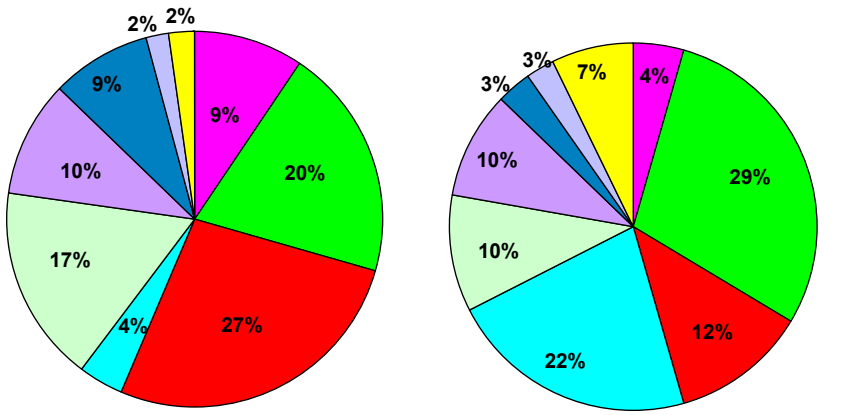


Female: 20,176 **Male: 24,728**

Psychology | Science & Math | Education | Engineering | Lib, Fine Arts, Arch
Soc Sci & Serv | Health | Business | Other

Source: US DOE, IPEDS on NSF's WebCASPAR THECB 7/2004

Doctoral Degrees Awarded by Texas Public and Independent Institutions by Gender and Discipline in 2001: 2,752 Degrees



Female: 1,200 **Male: 1,552**

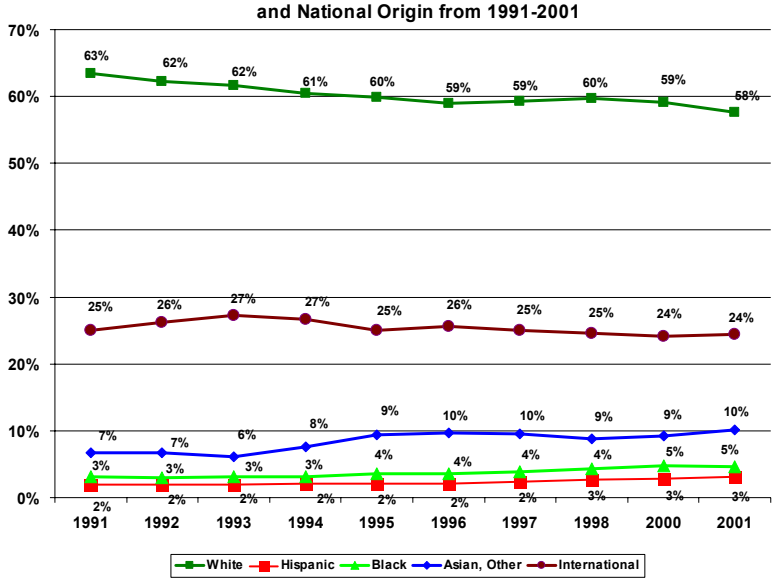
Psychology | Science & Math | Education | Engineering | Lib, Fine Arts, Arch
Soc Sci & Serv | Health | Business | Other

Source: US DOE, IPEDS on NSF's WebCASPAR THECB 7/2004

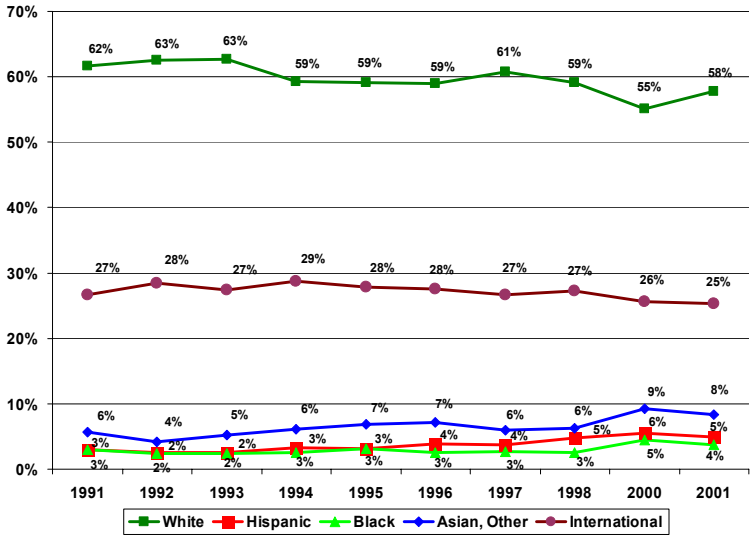
G. Degrees by Ethnicity

In Texas and the U.S., international students receive about one-fourth of the doctoral degrees awarded. The percentage of Blacks and Hispanics receiving doctorates has increased only slightly since 1991.

Doctoral Degrees Awarded by U.S. Institutions by Ethnicity and National Origin from 1991-2001

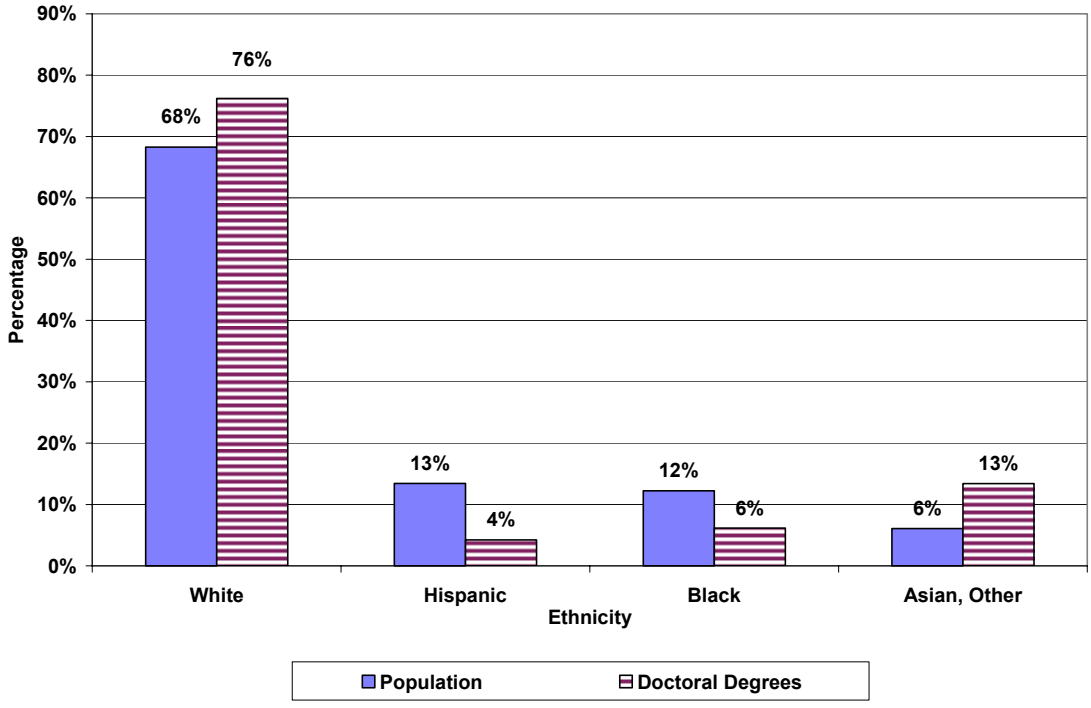


Doctoral Degrees Awarded by Texas Public and Independent Institutions by Ethnicity and National Origin from 1991-2001



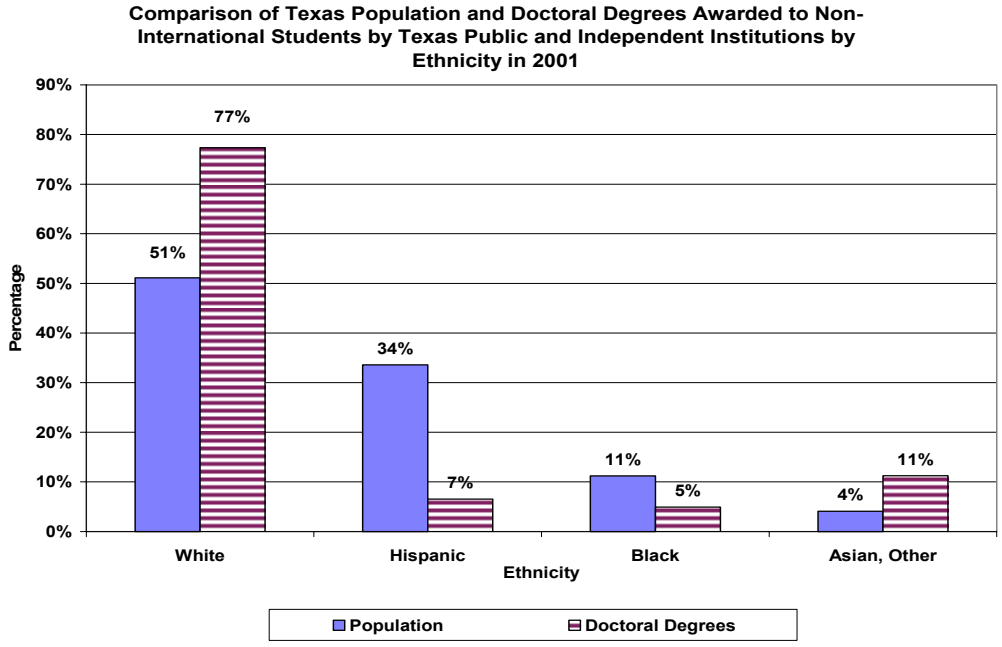
Blacks and Hispanics are underrepresented among recipients of doctoral degrees awarded by U.S. institutions to U.S. citizens. The same is true for Texas institutions and the Texas population.

Comparison of U.S. Population and Doctoral Degrees Awarded to U.S. Citizens by U.S. Institutions by Ethnicity in 2001

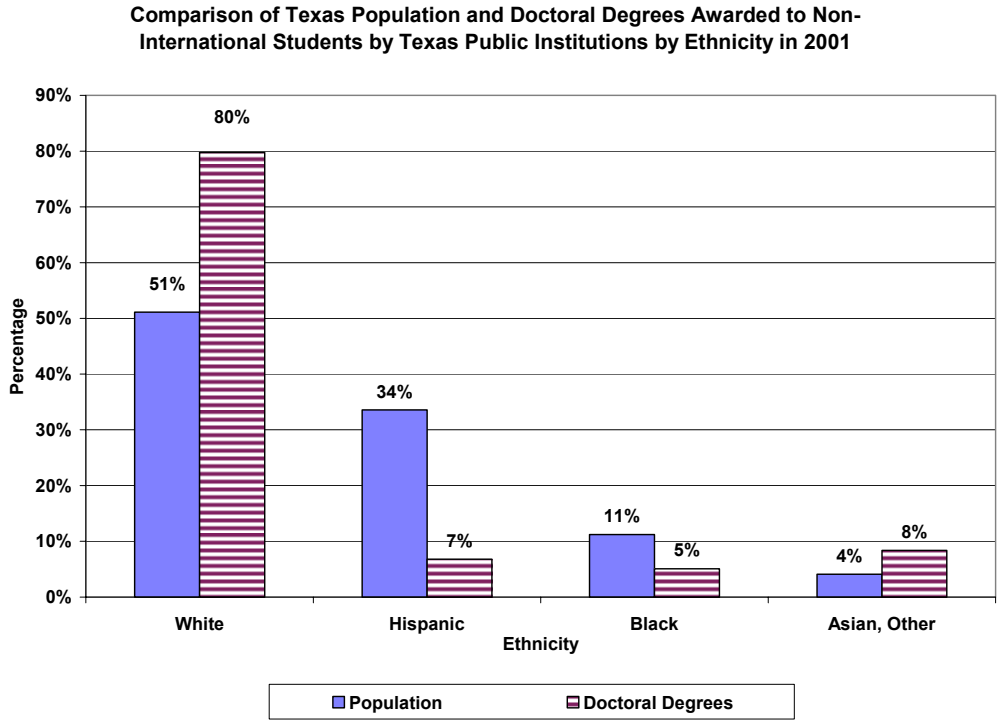


Sources: IPEDS on NSF's WebCASPAR, U.S. Census Bureau

THECB 7/2004



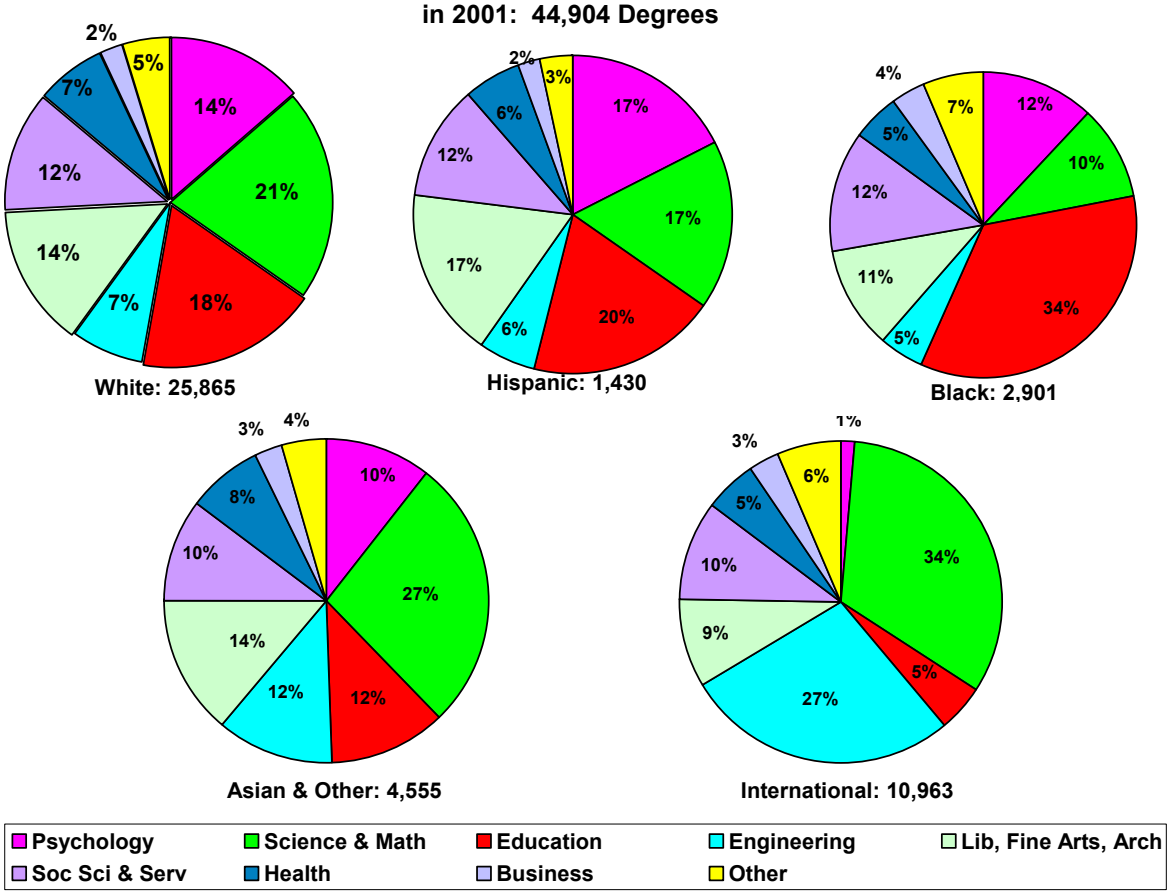
Sources: IPEDS on NSF's WebCASPAR, U.S. Census Bureau THECB 7/2004



Sources: IPEDS on NSF's WebCASPAR, U.S. Census Bureau THECB 7/2004

Doctoral degrees awarded to Blacks and Hispanics are concentrated in the field of education in the U.S., and even more in Texas. The percent of Hispanics and particularly Blacks receiving doctorates in the fields of science and math were lower than the percent of other groups receiving doctorates in these fields.

Doctoral Degrees Awarded by U.S. Institutions by Ethnicity and Discipline in 2001: 44,904 Degrees



Source: IPEDS on WebCASPAR

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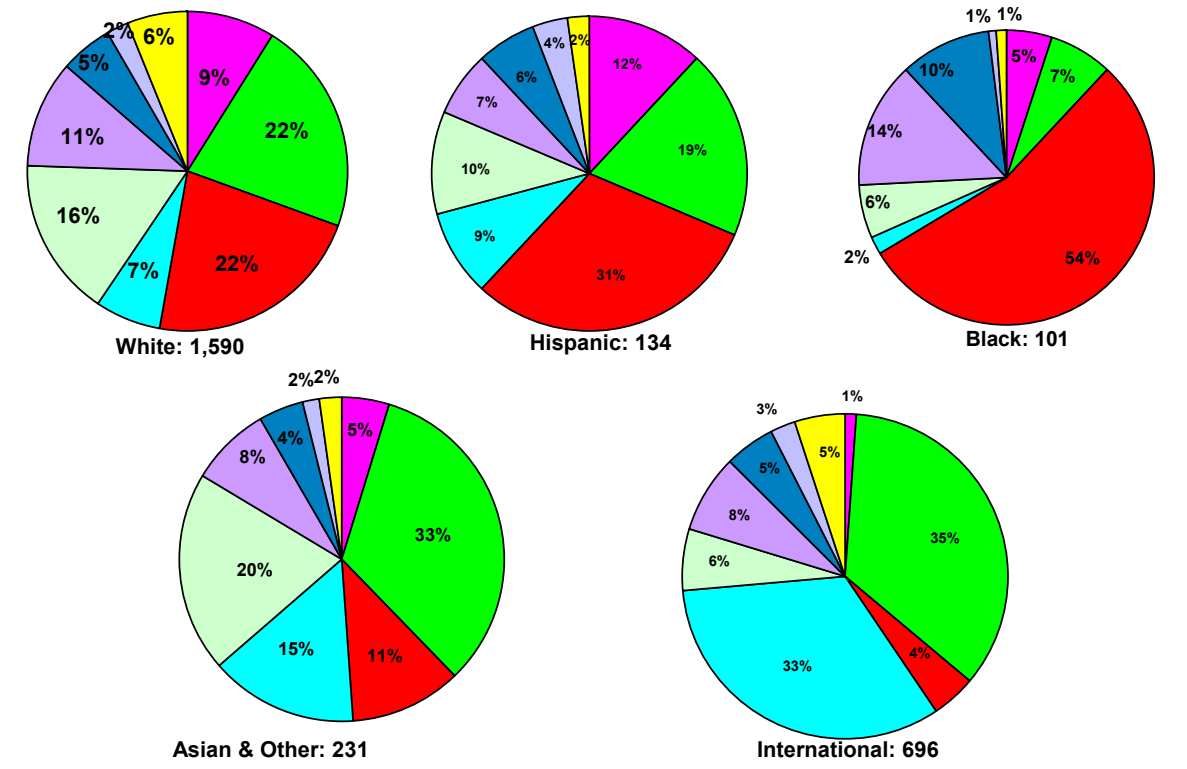
Doctoral Degrees Awarded by Texas Public and Independent Institutions by Ethnicity and Discipline in 2001: 2,752 Degrees



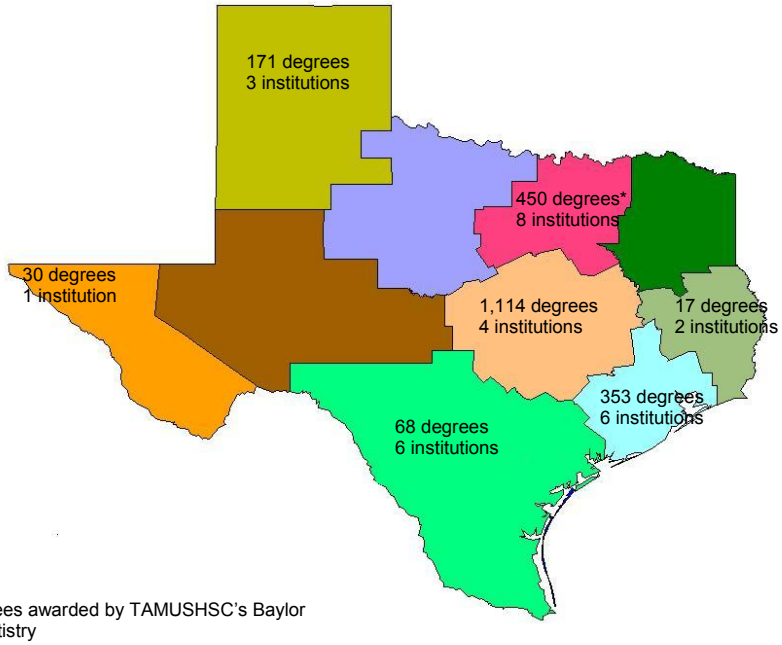
Source: US DOE, IPEDS on NSF's WebCASPAR

THECB 7/2004

H. Degrees, Discipline Areas, and Programs by Region in Texas

The University of Texas at Austin and Texas A&M University, both in Central Texas, account for more than one-half of the doctoral degrees awarded in the state.

Doctoral Degrees Awarded by Texas Public Institutions in FY 2003 and Number of Institutions with Doctoral Authority by Region



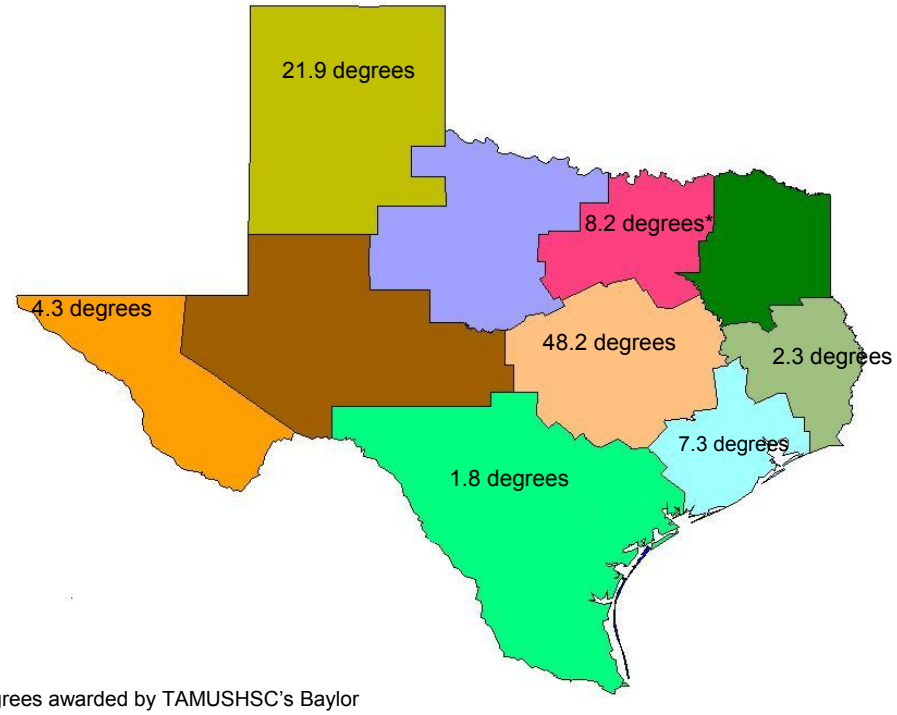
*Includes degrees awarded by TAMUSHSC's Baylor College of Dentistry

THECB, 7/2004

Source: THECB

Doctoral degrees awarded per 100,000 population are the highest in Central Texas and the lowest in South Texas (of the regions with institutions that award doctoral degrees).

Doctoral Degrees Awarded by Texas Public Institutions per 100,000 Population by Region FY 2003



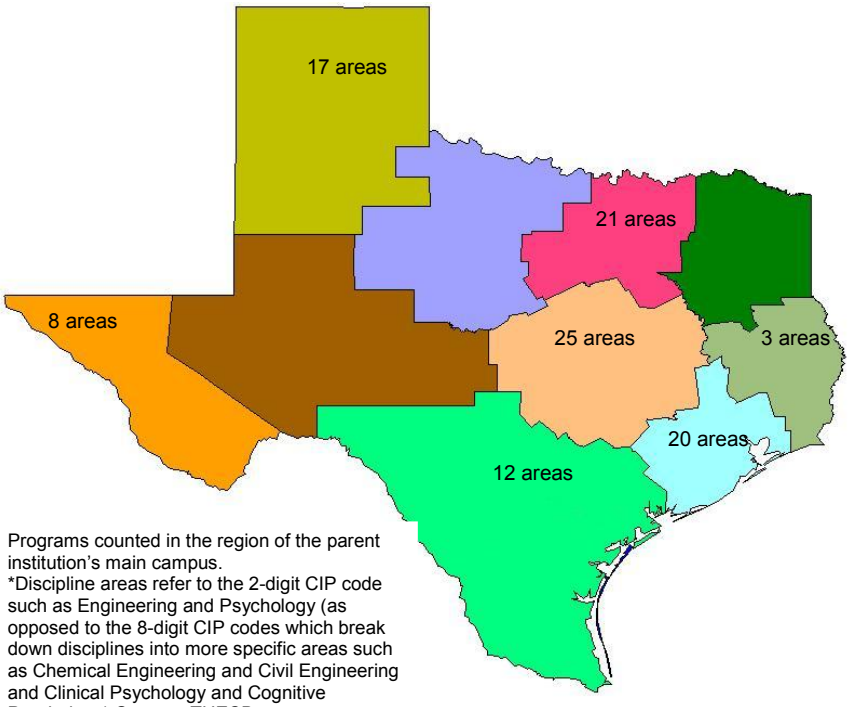
*Includes degrees awarded by TAMUSHSC's Baylor College of Dentistry

THECB, 7/2004

Source: THECB

The Central Texas, Metroplex, and Gulf Coast regions offer doctoral degrees in more discipline areas (e.g. Education, Psychology) than other regions of the state.

Doctoral Discipline Areas* at Texas Public Institutions by Region

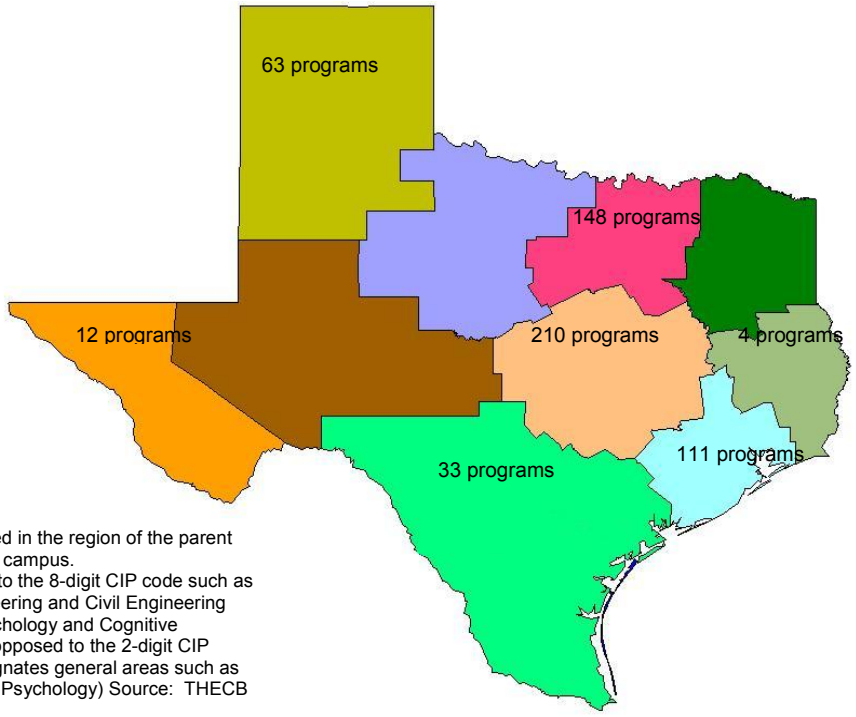


Programs counted in the region of the parent institution's main campus.
*Discipline areas refer to the 2-digit CIP code such as Engineering and Psychology (as opposed to the 8-digit CIP codes which break down disciplines into more specific areas such as Chemical Engineering and Civil Engineering and Clinical Psychology and Cognitive Psychology) Source: THECB

THECB, 7/2004

The Central Texas and Metroplex regions offer more doctoral programs than other regions of the state.

Doctoral Programs* at Texas Public Institutions by Region



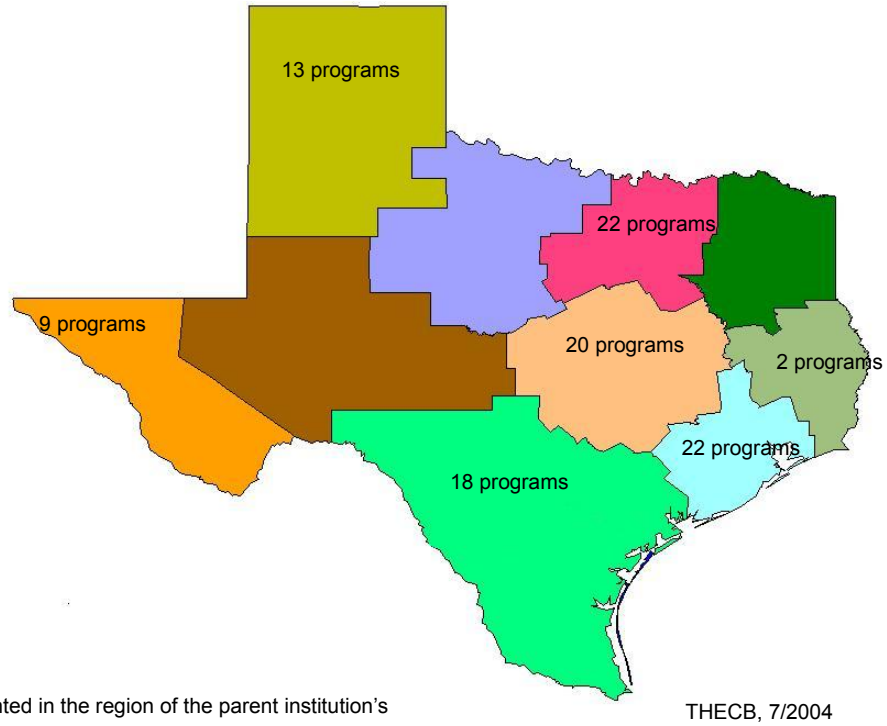
Programs counted in the region of the parent institution's main campus.
*Programs refer to the 8-digit CIP code such as Chemical Engineering and Civil Engineering and Clinical Psychology and Cognitive Psychology (as opposed to the 2-digit CIP code which designates general areas such as Engineering and Psychology) Source: THECB

THECB, 7/2004

Note: Program counts among institutions are not precise. Different counts can arise from different arrays of programs and disciplines. For example, one institution may offer only one doctoral degree in Physics, where another institution may have doctoral degrees in Theoretical Physics, Atomic Physics, and Solid State Physics.

The Central Texas, Metroplex, Gulf Coast, and South Texas regions have added more doctoral programs in the last 10 years than other regions in the state.

Doctoral Programs Created at Texas Public Institutions by Region
FY 1994 to FY 2003



Programs counted in the region of the parent institution's main campus.
Source: THECB

THECB, 7/2004

Texas Public Institutions Offering One or More Doctoral Degrees

INSTITUTION	No. of Doctoral Discipline Areas 2-Digit CIP[1]	No. of Doctoral Programs 8-Digit CIP[2]	Doctoral Degrees Awarded FY 2003
LAMAR UNIVERSITY	2	2	6
PRAIRIE VIEW A&M UNIVERSITY	4	4	0
SAM HOUSTON STATE UNIVERSITY	3	4	13
STEPHEN F. AUSTIN STATE UNIVERSITY	2	2	11
TARLETON STATE UNIVERSITY	1	1	0
TEXAS A&M INTERNATIONAL UNIVERSITY	1	1	0
TEXAS A&M UNIVERSITY	19	84	442
TEXAS A&M UNIVERSITY-COMMERCE	3	6	45
TEXAS A&M UNIVERSITY-CORPUS CHRISTI	1	3	6
TEXAS A&M UNIVERSITY-KINGSVILLE	3	4	18
TEXAS SOUTHERN UNIVERSITY	3	5	17
TEXAS STATE UNIV-SAN MARCOS	3	5	0
TEXAS TECH UNIVERSITY	17	53	166
TEXAS WOMAN'S UNIVERSITY	12	21	60
UNIVERSITY OF HOUSTON	16	51	207
UNIVERSITY OF NORTH TEXAS	14	57	157
UNIVERSITY OF TEXAS AT ARLINGTON	12	32	62
UNIVERSITY OF TEXAS AT AUSTIN	23	113	668
UNIVERSITY OF TEXAS AT DALLAS	10	18	70
UNIVERSITY OF TEXAS AT EL PASO	8	12	30
UNIVERSITY OF TEXAS AT SAN ANTONIO	8	13	6
UNIVERSITY OF TEXAS-PAN AMERICAN	2	2	8
WEST TEXAS A&M UNIVERSITY	1	1	
SUBTOTAL	168	494	1,992
UNIVERSITY OF TEXAS SOUTHWESTERN MEDICAL-DALLAS	4	11	42
UNIVERSITY OF TEXAS HEALTH SCIENCE CENTER-SAN ANTONIO	4	10	30
TEXAS A&M UNIVERSITY SYSTEM HEALTH SCIENCE CENTER	2	8	4
UNIVERSITY OF NORTH TEXAS HEALTH SCIENCE CENTER	2	2	14
TEXAS TECH UNIVERSITY HEALTH SCIENCES CENTER	2	9	5
UNIVERSITY OF TEXAS HEALTH SCIENCE CENTER-HOUSTON	6	37	83
UNIVERSITY OF TEXAS MEDICAL BRANCH GALVESTON	3	10	33
SUBTOTAL	23	87	211
TOTAL	191	581	2,203

*UT MD Anderson Cancer Center's doctoral programs are offered in conjunction with UTHSC-Houston. They are not shown here to prevent double counting.

[1]Broad discipline areas such as Engineering or Psychology

[2]More specific categories of disciplines, such as Chemical Engineering, Civil Engineering, or Clinical Psychology and Cognitive Psychology

Section III: Critical Issues Concerning Doctoral Education

Concerns and criticisms about doctoral education in Texas and the U.S. are numerous and significant. Those in and out of the academic community are raising the following questions: Is the U.S. producing too many doctoral graduates for the job market to absorb? Are doctoral programs excessively narrow and specialized? Do too many students drop out of their doctoral programs? Of those who stay, do they take too long to complete their degree? Are international students "overrepresented" in doctoral programs at the expense of U.S. students? Are Blacks and Hispanics underrepresented in doctoral programs and are enough efforts being made to increase minority participation in doctoral programs? Which "kinds" of institutions should offer doctoral programs, and in what disciplines? Do institutional aspirations for doctoral programs adversely affect undergraduate- and master's-level education? Should doctoral programs serve regional and state needs over national needs? Is the quality of doctoral education declining and are the "ratings" of doctoral programs meaningful?

This section will address these questions, beginning with the last one.

A. Quality of Doctoral Programs.

> "When your program is ranked by *U.S. News and World Report*, magic things can fall from the sky." (comment from a University of California at San Diego professor on a doctoral site visit at The University of Texas at San Antonio, 2003)

Publications such as *U.S. News and World Report* produce annual national rankings of doctoral programs in selected disciplines. Educational organizations such as the National Research Council (NRC) have also generated ratings of doctoral programs. While highly rated programs gain prestige (and tangible benefits) from their appearance on these lists, many in the academic community question the validity of these rankings as accurate indicators of quality. Both *U.S. News* and the NRC (in its comprehensive 1995 study) rely, in part, on "reputational data" in which faculty peers (and administrators) provide quality judgments of other programs in their respective disciplines. Ratings, therefore, can be self-perpetuating; i.e., highly rated programs maintain their ratings partially because their reputations are already bolstered by previous appearances on ratings lists. In a recent publication, the NRC acknowledged that at the very least, the precision that these numerical rankings imply is not justified.

There are, however, many quantifiable quality indicators of doctoral programs. The following matrix shows quality measures commonly applied to doctoral programs.

POTENTIAL QUANTITATIVE QUALITY INDICATORS[1] OFTEN APPLIED TO DOCTORAL PROGRAMS

Student Measures	Faculty Measures	Program Measures
• Number of students who applied/ number accepted/ number enrolled • Undergraduate GPA (and master's if applicable) of enrolled students • GRE scores of enrolled students • Graduation rate • Time-to-degree • Degrees awarded/year • Passing rates for licensure and certification (if applicable) • Number of graduates employed in field within one year of graduation	• Number of core (program) faculty by rank: assistant/ associate/full • Faculty teaching load • Faculty scholarship by recent - Number of publications in main peer reviewed journals - Number of books - Number of book chapters - Number of invited papers • Number of publications/FTFE/year • Faculty research by current - Number of externally funded federal grants - Total dollar amount of externally funded grants • Number of grants/FTFE • Number of dollars in grants/FTFE • Number of patents issued • Net revenue from intellectual property	• Percent of students who are full-time • Percent of full-time students with fellowships or research or teaching assistants • Dollar amount of research and teaching assistant stipends • FTSE/FTFE • Volumes of library resources – hard copies and online materials • Value of equipment for program • Square feet of space for program

[1] These indicators came from several sources, including *A Study of Quality Indicators for Graduate Programs* – Western Michigan University, *The University of Texas System Accountability and Performance Report Framework and Performance Measures 2003*, Coordinating Board rules, and other Coordinating Board materials.

Despite the availability of these quantitative indicators of quality, there is no definitive or singular methodology to evaluate doctoral programs. The different weights that evaluators could apply to these measures could clearly produce different results. Contextual variables such as the overall number of doctoral programs offered at the institution can and should also be considered when applying any formulaic methodology to evaluating doctoral programs.

Although there is neither consensus nor precision in evaluating the quality of doctoral programs, judging the effectiveness of these programs remains an important responsibility. And given the recent emphasis placed on accountability in Texas and elsewhere, these judgments, even if imprecise, provide necessary information to policy makers and others in the state. Later portions of this report will discuss some specific measures of quality (as indicated in the matrix) and their relative importance.

B. Differentiated Missions and Doctoral Education

> "Higher education's commitment to improvement has come to be based largely on the Carnegie Classification System and National Research Council's rankings, which privilege the research model and drive a prestige economy resulting in an increase in PhD programs across the country." (from *Re-envisioning the PhD: What Concerns Do We Have*, University of Washington, a report funded by the Pew Charitable Trusts, 2000)

The Texas Higher Education Plan, *Closing the Gaps by 2015*, states that "different types of institutions. . . should focus on strengthening their own unique missions." Clearly, there is and should be great diversity among our higher education institutions. However, determining which institutions should have doctoral programs and in which disciplines is a challenge for Texas and other states.

The California Model. California addresses this issue through its *Master Plan for Higher Education*. Adopted in 1960, the plan assigns each of three public segments of higher education its own distinctive mission (and potential pool of students). The nine University of California (UC) campuses are the state's primary academic research institutions, providing undergraduate, graduate, and professional education. Within that group, three institutions (UC-Berkeley, UCLA, and UC-San Diego) are seen as having the broadest graduate research missions. The mission of the 23 campuses of the California State University (CSU) System is to provide undergraduate education and graduate education through the master's degree, with particular emphasis on applied fields. The UC campuses have exclusive authority for doctoral education with some limited exceptions in which CSU universities can offer joint doctoral programs with other UC or independent institutions. (The third segment of public higher education is the California Community College System).

While not without criticism, the California Master Plan has been praised as a rational, coherent system that 1) eliminates unnecessary competition among institutions, 2) concentrates valuable resources needed for doctoral education and research into a limited (but not exclusive) number of institutions located throughout the state, and 3)

establishes a framework that encourages different types of institutions to reach excellence within their own mission.

Without such a clean differentiation of institutional functions in Texas public higher education, individual institutions (and their board of regents) in the state have more "mission autonomy" and opportunities for change. While this flexibility can be a positive characteristic of a higher education system, a coordinated statewide vision is advisable to guide growth in the number of new degree programs, especially doctoral programs.

Carnegie Classification. Many institutions in Texas and elsewhere look to the Carnegie Classification of Institutions of Higher Education as a framework for designating institutional function. The Carnegie Foundation is a non-profit higher education organization that publishes its classification system, which groups higher education institutions together, based on "institutional functions" as indicated by level of degrees awarded and the number of disciplines in which they are awarded. But unlike the California model that designates which institutions are able to grant doctoral degrees, *the Carnegie Classification system merely reflects what a given institution is like (as measured by the Carnegie definitions) at a certain point of time.*

The Carnegie Classification System has changed several times. The current Classification, introduced in 2000, has two types of doctoral-granting institutions, two types of master's-granting institutions, three types of baccalaureate-granting institutions, and a category for associate-granting institutions. The two doctoral categories are distinguished as:

> Doctoral/Research Universities — Extensive: These institutions are "committed to graduate education through the doctorate…and award 50 or more doctoral degrees per year across at least 15 disciplines."
>
> Doctoral/Research Universities — Intensive: These institutions award "at least 10 doctoral degrees per year across three or more disciplines, or at least 20 doctoral degrees per year overall."

Six of Texas' 35 public universities (17 percent) are classified as Doctoral Extensive Universities and another six public universities (17 percent) are listed as Doctoral Intensive. In comparison, eight of California's nine UC universities are listed as Doctoral Extensive institutions and the remaining UC campus is a Doctoral Intensive institution. (One CSU institution is also listed as a Doctoral Intensive university because it offers a number of joint doctoral programs with other institutions.) Therefore, 25 percent of California's public universities are Doctoral Extensive and 6 percent are Doctoral Intensive. Nationwide, 19 percent of public senior colleges and universities are listed as Doctoral Extensive and 12 percent are classified as Doctoral Intensive.

The Carnegie Foundation provides its Classification of Institutions as a research tool. By grouping institutions by some common measures, the Classification allows institutions to identify peer institutions for comparison purposes. The Foundation recognizes that its Classification is but one of a number of ways to cluster institutions by

function and that no one taxonomy can capture the complexity and diversity of higher education institutions. The Foundation also makes clear that the Classification *is not a ranking system* and cautions institutions not to use the Classification as a "policy lever to drive institutional change." Despite these directives, the Foundation recognizes that competition among institutions has led some campus administrations to aspire to "move up the Carnegie Classification as an explicit institutional goal."

In fact, when the Foundation revised its Classification in 2000 (from the previous 1994 edition), some of its changes reflected this concern. It reduced the number of categories of doctoral-granting institutions from four to two, in part, to deflect institutions' efforts to use the Classification as an academic hierarchy. Institutional mission change is not improper, and institutions add doctoral programs for many legitimate academic reasons. As institutions grow and add programs at different levels, their Carnegie classifications may indeed change. However, the Carnegie Foundation believes that institutional growth and change just for the sake of Carnegie mobility is not a commendable educational goal.

Growth of Doctoral Programs and Institutional Aspirations. Whether driven by Carnegie status or not, many institutions in Texas have added doctoral programs in recent years. The following table shows the number of new doctoral programs initiated (and closed or consolidated) at Texas public universities and health-related institutions.

Number of Doctoral Programs Initiated and Closed or Consolidated at Texas Public Universities and Health-Related Institutions from 1993-2003

Fiscal Year	New[1]	Closed or Consolidated[2]
1994	6	7
1995	13	19
1996	6	14
1997	15	6
1998	6	6
1999	4	4
2000	11	9
2001	8	10
2002	17	5
2003	20	20
FY 1994-2003	106	100

[1] New programs include distinct majors under the same general area. For example, Business Administration-Accounting and Business Administration-Finance at The University of Texas at San Antonio were counted as two new programs.

[2] Approximately 10% of the programs were closed and 90% were consolidated (combining different specialty areas into one). For example, at Texas A&M University, Physical Anthropology, Cultural Anthropology, and Anthropology-Archaeology were combined into one doctoral program in Anthropology.

The number of doctoral programs established in Texas in each of the last two years is greater than in any of the previous eight years. And the 10-year total of 106 new doctoral programs compares to 271 new bachelor's programs and 334 new master's programs during the same period. Of the 711 new degree programs created in the last 10 years, nearly 15 percent were doctoral programs.

Institutional interest in doctoral programs occurs for many reasons. Certainly, some new doctoral programs begin as a direct response to an overt need for doctoral-level expertise in a particular discipline at the regional, state, and national levels. Other programs are developed to tap into a particular institutional interest (or historical involvement) in a particular discipline; this interest is often a result of the institution's proximity to natural resources associated with the discipline. Faculty can also drive the desire for a new doctoral program. For example, faculty may wish to have more opportunities to do research in the field, to mentor doctoral students, or to be part of a program which is similar to the one in which they received their doctoral education. Finally, while difficult to quantify, some institutions may seek doctoral programs in response to political expectations or in a quest to potentially enhance the prestige of their institutions.

Of course, in many cases doctoral programs are created for a combination of some or all of the above reasons. And there is no harm for an institution to note its Carnegie Classification change as it adds programs. However, the Coordinating Board staff believe that there is a need for more state guidance, beyond that provided by the *Closing the Gaps* plan and the current mechanism for granting planning authority, for the development of doctoral education in Texas.

C. Attrition and Time-to-Degree

> "There must be a breakthrough on time-to-degree, and I don't think that is uniformly part of the way faculty members think and behave. We fool ourselves into believing that the best times in the lives of these students are when they are under our wing." (from a faculty respondent to a survey as conveyed in *Re-envisioning the PhD: What Concerns Do We Have*, University of Washington, a report funded by the Pew Charitable Trusts, 2000)

Two common criticisms of doctoral programs are that not enough students finish them and those that do finish take too long to complete their studies. These issues significantly affect many doctoral students and affect the efficient use of the resources Texas provides its institutions.

Attrition. There are no comprehensive national statistics available on attrition rates of doctoral programs. However, the *Chronicle of Higher Education* and the Carnegie Foundation report that several institution-specific studies (and some state studies) indicate attrition rates of doctoral programs are 40 to 50 percent. (Attrition rates for doctoral students in Texas are not available. Coordinating Board staff will review this issue and develop recommendations, if warranted.) In general, attrition is highest in the humanities, then social sciences, and lowest in the sciences. Women are more likely to

leave doctoral studies than men, American students leave at higher rates than international students, and Hispanics and Blacks are more likely to leave than Whites.

Most studies suggest that students leave not so much for academic reasons but because of either financial reasons or a lack of significant involvement in the department and program. Students holding either research or teaching assistantships are in the best position for meeting these concerns. Assistantships provide financial support and opportunities for students to interact with other students (graduate and undergraduate) and with faculty. (Graduate assistants have office or lab space at the institution.) A science graduate assistant, in particular, is integrated quickly into department life, as he or she is usually assigned (even if temporarily) to a professor's lab upon entry into the doctoral program. The doctoral student usually works closely with the faculty member and with students.

Those in academia do not expect that doctoral programs will reach the completion rates of clearly defined professional degrees like law and medicine. Doctoral programs will also likely have higher attrition rates than master's programs, which are considerable shorter in length than doctoral programs. However, given the significant financial investment by institutions, by states, and by the federal government in doctoral education and the considerable personal investment by students, all parties must increase efforts to improve the completion rates of doctoral students.

Time-to-degree. The process of completing a doctoral degree varies widely by institution (and departments within an institution), by discipline, and, of course, by student. The National Science Foundation reports that the national median "registered time-to-degree" (the total time a student is enrolled in a doctoral program from after completion of a baccalaureate degree to the receipt of the doctoral degree) was 7.6 years (in 2002). This figure has been rising steadily over the last 30 years. (Time-to-degree in 1972 was 5.8 years; 1982, 6.5 years; 1992, 7.2 years.)

Time-to-degree is considerably higher in education and the humanities than in engineering and the sciences (although some doctoral graduates in the sciences complete a post-doctorate position before seeking permanent work). Also, time-to-degree for Blacks is higher than for other ethnicities.

The Council of Graduate Schools reports that some of the same factors affecting attrition rates also affect time-to-degree, including adequate financial support and effective faculty mentoring. Part-time students, such as many in the field of education, take longer to graduate than full-time students. Of course, the actual degree requirements (number of semester credit hours, number and type of qualifying exams, and dissertation requirements) directly affect time-to-degree. Institutional desires to ensure both breadth and depth of disciplinary competence for students result in additional semester credit hours to the curriculum. (See next section.) While this is especially true of programs that are by their very nature interdisciplinary (such as environmental sciences), students in more focused disciplines also benefit from exposure to related fields as advocated in the *Re-envisioning the PhD* report. In addition, doctoral programs want to expose their students to multiple research methodologies to ensure that students' research capabilities extend beyond the techniques used in their dissertations. And in response to concerns

that doctoral education only prepares graduates to conduct research, some doctoral programs add pedagogy courses as part of the required curriculum. The motivation behind these efforts is laudable, and the benefits received by students are often important, but they can also result in lengthening time-to-degree. Therefore, higher education officials should continually evaluate doctoral degree requirements to balance their benefits against maintaining a reasonable time-to-degree for students.

D. Specialization of Doctoral Education: Depth versus Breadth

> *Metabolic engineering of enhanced hemolysin secretion in Escherichia coli by substitution of synonymous codons based on genomic and proteomic analysis* (dissertation from student at Cornell University, 2004)

An inspection of some doctoral dissertation titles (like the one above) raise concern that doctoral education has become a pursuit of vary narrow specialized research within a discipline (or sub-discipline) that has little or no utility to the real world. Accordingly, some people suggest that doctoral graduates could be ill-prepared to participate in a more global, team-oriented, inter-disciplinary workforce, whether in academia, government, or industry.

However, one needs to look beyond the dissertation to examine the validity of these concerns. While some dissertations can be extraordinary narrow, a measure of specificity should be expected because a dissertation should create new knowledge in the field. In addition, dissertation findings can sometimes be generalized to broader applications. Most importantly, the process itself of formulating research questions, selecting and applying a methodology, and determining the results can (and should be) applicable to multiple settings. Finally, it demonstrates the student's mastery of these processes and suggests the benefits of future work products.

Still, the struggle between depth and breadth in doctoral education is a real one. The cultures of some doctoral programs foster a disciplinary isolation, which then transfers to doctoral students and their research. Certainly, curricular and research depth bring potential benefits to the students who can become and claim to be experts in a particular area. However, potential employers in industry, government, and even academia also want graduates with "transportable skills" that can be applied in varied circumstances. And creating new knowledge in the workforce often means bridging the connections between disciplines. Such workforce requirements call for a broader curricular approach to doctoral education and for more opportunities for doctoral students to work collaboratively with others in and out of their field. Institutional efforts to broaden doctoral education include:

- Curricula that are more interdisciplinary;
- Curricula that include required minors or at least cluster of courses in areas outside the students' specialized discipline (e.g., economics for political scientists or computer science for physicists);
- Research courses that require students from different fields to work together on a project;

- Dissertation studies in which faculty from outside the department and/or from industry or government are significantly involved with the students' work; (While it is traditional that students must have a least one committee member from outside the department, this person often plays a modest role in the dissertation study.)
- Pedagogy courses to enhance teaching skills;
- Doctoral internships in industry or government settings; and
- Teaching and research assistantships.

Of course, these efforts take time and potentially contribute to a higher time-to-degree for students. As mentioned in the previous section, the benefits of these practices must be weighed against adding to the time students take to graduate. However, graduates with broad-based competences and the ability to transfer critical thinking and analytical skills to different circumstances are becoming more valuable to the workforce.

E. Diversity in Doctoral Education

> **"**More than one-third of the nation's workers are people of color. So are more than one-fourth of America's college students. But the percentage of racial/ethnic minorities who are faculty in higher education is a small fraction of the total. The primary reason that there are not enough racial/ethnic minority faculty is that too few minorities earn doctoral degrees and choose to become members of the teaching and research staffs at colleges and universities." (Mark Musick, President, Southern Regional Education Board in *Diversity in College Faculty: SREB States Address a Need*, a special report, 1999)

According to the U.S. Department of Education, approximately one of every four recipients of a doctoral degree in the U.S. (and Texas) is an international student. Only 4 percent of the doctoral degrees awarded to U.S. citizens across the nation went to Hispanics, and 6 percent went to Blacks in 2001. These figures for Hispanic and Black students compare poorly to the 13 percent and 12 percent representation of these groups (respectively) in the general U.S. population. In Texas, Hispanics and Blacks are also underrepresented in doctoral education. Hispanics received 7 percent of doctoral degrees awarded to non-international students in Texas, but they represent 34 percent of the state's population. Blacks received 5 percent of doctoral degrees awarded to non-international students in Texas, but they represent 11 percent of the Texas population. Whites and Asians are relatively overrepresented in doctoral education in both the U.S. and Texas. There are many concerns about the above figures from inside and outside of higher education.

International Students. In fall 2003, at The University of Texas at Austin, there were 1,969 international students enrolled in doctoral programs, compared to 1,728 Texas residents. At Texas A&M University, there were 1,589 international students enrolled in doctoral education, compared to 1,170 Texas residents. Two other Texas public higher education institutions had more international students than Texas residents

in doctoral programs. As data presented earlier in this study indicate, international students make up a particularly high percentage of doctoral students in sciences, math, and engineering. Despite the many criticisms of U.S. doctoral education, the rest of the world continues to send its students to American institutions. But concerns in the U.S. about international students crowding out American students and competing in the U.S. job market arise frequently from several sectors.

While international students who remain in the U.S. clearly compete with Americans for jobs, the Association of American Universities (AAU) suggests that efforts to limit or reduce the international presence in U.S. doctoral education are unwarranted. The AAU notes that some of the strongest students enrolled in doctoral education in the U.S. are international students, and these students therefore enhance the intellectual (and cultural) climate of these programs. In addition, the international students that stay in the U.S. after graduation (about half) are assets to their employers, and those that leave the U.S. strengthen the workforce of their native countries. These students can also take back with them a better understanding of U.S. culture.

Rather than discourage enrollment of exceptional international students, which (by percentage) has remained relatively constant over the last 10 years, the AAU and others advocate trying to develop the U.S. talent pool, particularly Black and Hispanic students.

Black and Hispanic Students. The concern about under-representation of Black and Hispanic students has been expressed for decades. In an ideal educational system, you would expect (and desire) proportional representation from all sectors of the overall population to participate in all levels of education. Because of the under-representation of Blacks and Hispanics in doctoral education, these groups are also underrepresented in fields that require doctoral degrees, such as in academia. Of the faculty at Texas public universities, only 7.7 percent are Hispanic and only 4.8 percent are Black. In what is often described as a self-perpetuating cycle, the lack of Black and Hispanic role models in faculty positions (and in government and industry) can discourage, or at least fail to encourage, Black and Hispanic undergraduates from seeking advanced degrees.

Of particular concern is the lack of Blacks and Hispanics in particular fields of doctoral education. As indicated in Section II, a fifth of Hispanics and over a third of Blacks in doctoral education in the U.S. are concentrated in the field of education. In Texas, nearly a third of doctoral degrees awarded to Hispanics in 2001 were in education fields and over a half of doctorates awarded to Blacks were in education. The percent of these two groups receiving doctorates in the fields of science and math were considerably lower than the percent of other ethnicities receiving doctorates in these fields. The AAU places primary responsibility for change upon the nation's universities and suggests that these institutions work with both K-12 and undergraduate institutions to encourage Black and Hispanic students to prepare for and pursue doctoral education; the pipeline for these students to enter doctoral education must be expanded. The under-representation of Blacks and Hispanics in doctoral education continues to be a troubling problem.

F. Workforce Needs

> "There is considerable evidence that there are far more job seekers than there are tenure-track jobs available, and that this structural imbalance, rather than being temporary is the new status quo." (from *At Cross Purposes: What the Experiences of Today's Doctoral Students Reveal About Doctoral Education,* a report for the Pew Charitable Trusts, 2001*)*

While there are no governmental sources for employment data that capture the entirety of U.S. doctoral education, a number of national surveys (such as in the Pew report referenced above) have produced significant information about the workforce demand for and supply of doctoral graduates.

Tenured Faculty Positions. The Pew report shows that less than half of doctoral graduates eventually work as tenure-track faculty at universities and health-related institutions, and employment and student interest in these positions vary considerably for different disciplines. For example, only 60 percent of English doctoral graduates end up as tenure-track faculty, versus 80 percent who desire such positions. In chemistry, less than 20 percent of doctoral graduates end up with tenure-track positions versus over 35 percent who wish to be tenured faculty. Higher job interest for faculty positions from English graduates generally reflects the more limited career options for doctorally trained English majors. (Philosophy doctoral graduates expressed the highest interest in tenured positions, at nearly 90 percent.) In contrast, chemistry doctoral graduates have significant job opportunities in industry. Still, since interest in faculty jobs exceeds available positions in nearly all disciplines, supply exceeds demand with respect to academia. (This may change, as indicated below.) There are a few exceptions in some disciplines, such as nursing, in which there is a nation wide shortage of doctorally trained nursing faculty.

Non-Tenured Faculty and Community College Positions. Some doctoral graduates who do not receive tenured positions accept non-tenured positions at universities and health-related institutions. Individuals with these positions are often part-time and have no guarantee of employment beyond a semester or year. Some non-tenured positions can be full-time, but are still "temporary." Occasionally, institutions will hire permanent, non-tenured faculty as "instructors" or "lecturers." While permanent, these positions are paid less (usually significantly) than tenured positions and offer little or no opportunity for faculty to pursue research interests. The number of non-tenured faculty at universities and health-related institutions has increased in the last several years, largely to reduce faculty costs. The AAU reports that 30 percent of university faculty positions nationwide are non-tenured. To most faculty, however, these positions are not as desirable as tenured positions. And while these faculty are often excellent instructors, many in academia feel that too many non-tenured faculty can diminish the academic quality and scholarly environment of an institution. Texas, operating under the premise that tenured and tenure-track faculty provide the highest quality instruction, encourages universities to use more tenured and tenure-track faculty by providing a 10 percent increase in formula funding for lower-division courses taught by these faculty.

Many doctoral graduates have careers as faculty at community colleges. According to the 2001 Pew Report, 20 percent of full-time faculty in the U.S. (and many more part-time faculty) teach at community colleges. The report also indicated, however, that less than 4 percent of doctoral students strongly prefer positions at community colleges.

Despite the current oversupply for tenured positions (in most disciplines) and despite the possibility of less desirable non-tenured positions, the lure of academia is strong for many doctoral students. The 2001 Pew report states that many students are unaware of the challenging job market for tenured positions and have a "naïve optimism" toward their job prospects. Others want to test the market and compete for academic jobs despite an accurate knowledge of a difficult job market.

The Aging Professoriate. Hopes for an increase in the number of available faculty positions rest in large part on expectations of significant faculty retirements in the next few years. A survey conducted by the Higher Education Research Institute at the University of California at Los Angeles in 1999 indicated that nearly a third of the full-time faculty in the U.S. were 55 or older. Most members of this "graying professoriate" were hired in the 1960s and early 1970s as a result of an influx of "baby boomers" then entering higher education institutions. As a group, these faculty are at an age or nearing an age when many faculty retire.

With these retirements, not only will new doctoral graduates have opportunities for faculty positions, but institutions will have opportunities to bring in faculty with new and different areas of expertise and ideas about teaching. In addition, new hires can address institutional concerns about gender and ethnic diversity, as many retiring faculty are disproportionately white and male. However, with the elimination of forced retirement of postsecondary faculty in 1993 (as a consequence of the expiration of amendments to the Age Discrimination in Employment Act), it is difficult to predict with precision the retirement patterns of these faculty. Some faculty are remaining at institutions into their 70s. Even with a substantial amount of faculty turnover, there are few predictions of a reversal of the supply and demand patterns of doctoral graduates and faculty positions. Also, cost constraints are likely to continue to affect the number of the tenure-track positions in higher education.

Non-Academic Positions. While competition for tenured positions remains tight, the percentage of doctoral recipients obtaining employment outside of academia is increasing. There are attractive career choices for doctoral graduates in business, government, health-related facilities, and non-profit organizations (with graduates in various disciplines facing varying challenges in justifying the relevance of their degrees to employers in these fields). Doctorally-trained engineers for example, find work in industry in positions that require the research skills that they possess. In fact, the AAU reports (through a survey from the National Research Council) that two-thirds of doctoral graduates in engineering are employed in non-academic positions. And nearly half of doctoral graduates in the sciences also find work outside academia. Because of opportunities in industry and government for doctoral graduates, many higher education stakeholders feel that institutions should promote non-academic positions as having an

equal status as faculty positions and should devise doctoral programs that prepare students equally for careers inside and outside of academia.

Matching Need and Job Skills. While survey data, such as in the 2001 Pew report, reveal much about doctoral-level placement and employment, it is not possible to quantify precisely the need for doctoral graduates in various disciplines, particularly in industry and government. Unlike academia, in which a doctorate is needed (or at least desirable), the need for doctorally trained graduates in non-academic positions is much more variable. Certainly doctoral graduates take positions in which a doctorate (and doctoral-level research skills) are not required or asked for. Also, some employers may favor applicants with doctorates (or require a doctorate) even though the position will not draw meaningfully on the employee's doctoral training. Both situations are probably inefficient, and the oversupply of doctoral graduates in academia (in most disciplines) remains problematic.

Accordingly, some stakeholders outside of academia encourage institutions to take greater control over the number of doctoral students admitted into their programs. Some academicians believe, however, that the intellectual benefit of a doctoral education has value outside the job market and that society benefits from a more highly educated populace. They argue that if students want to earn doctorates in fields with limited job opportunities, then they should be allowed to do so. But with the state bearing much of the cost of such an education at public institutions, in economically challenging times, and with increasing competition for state resources, it is difficult to justify such outcomes without more overt benefits to the state.

G. Regional Needs versus State and National Needs

> "As a small doctoral program serving the local area, the program as proposed is likely to be viable in the short run. However, in the longer term a regional program is very likely to experience serious difficulties. Because this discipline at the doctoral level is in a highly specialized field, a regional program is likely to experience increasing difficulty over time in attracting qualified students and placing graduates in positions that make good use of their expertise." (from a consultant report for a proposed Texas doctoral program, 2003)

As indicated in Section I, doctoral education inherently has much more of a national scope than most baccalaureate and master's programs. Institutions recruit students on a national and international basis, and graduates often seek employment far from the institution from which they received their doctorate. There are several reasons for this.

The job market for doctorally trained graduates can be limited, and applicants must often extend job searches well beyond a particular region to obtain employment. This is particularly true for jobs in academia. As a general rule, institutions do not hire their own graduates for tenure-track faculty positions. Therefore, potential faculty jobs in the region are largely limited to community colleges or at the local university in a non-

tenured position. These positions, as indicated previously, are often part-time and mostly non-permanent.

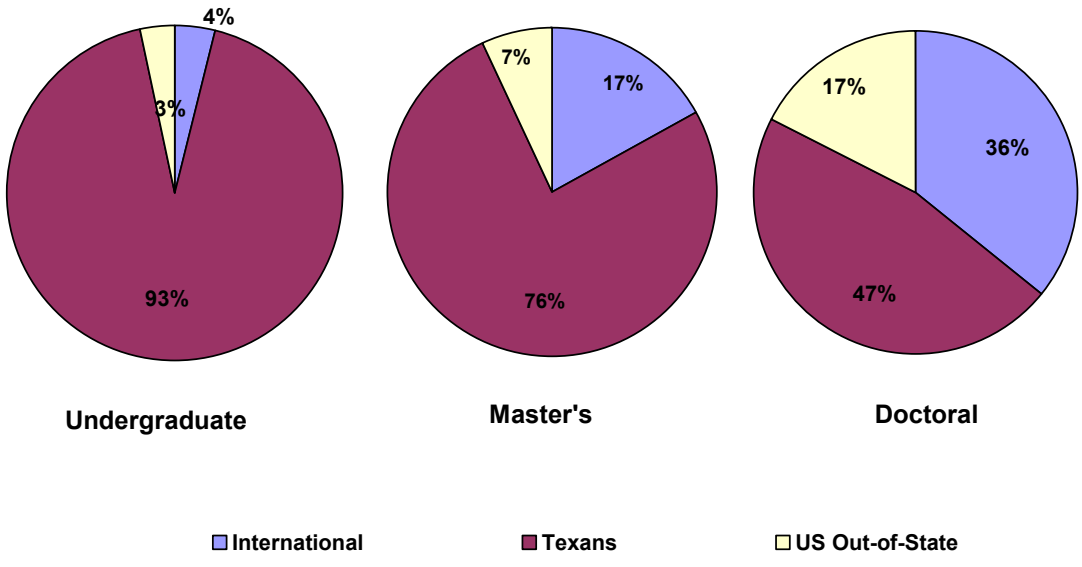
While governmental agencies and businesses hire doctoral graduates from local universities, there are often a limited number of positions that demand doctoral-level expertise. With a local university or health-related institution graduating a continuous supply of doctorally trained individuals in a given field, the local market in all but the largest cities and in all but the most fluid fields will likely become saturated within time. For these reasons, doctoral graduates often have the best job opportunities outside the region of the university.

Institutions must also look outside the region when *recruiting* doctoral students. While doctoral programs attract local students, after a period of time, the student pool in a region will begin to diminish for given doctoral programs. Most people in academia agree that it is healthy and desirable that doctoral programs have a national and international focus. Universities and health-related institutions do not hire their own doctoral graduates because it is best if new faculty from different educational environments bring different ideas and fresh perspectives to apply to their respective disciplines. It is also desirable to draw students into doctoral programs from different undergraduate universities, from different parts of the state and nation, and from different countries. Such diversity enriches the doctoral experience for all.

There are some exceptions to the need for nationally based doctoral programs. Doctoral programs in large metropolitan areas have much larger student pools to draw from, and the job market in the region can potentially absorb many graduates. The same is often true of the first few years of a new doctoral program even in smaller areas, as students are ample and jobs for graduates are available. In addition, doctoral programs in some disciplines can be sustained on a regional basis. For example, many Educational Administration (or Educational Leadership) doctoral programs (particularly EdD programs) have steady demand from students (sometimes as cohorts) who already hold administrative positions in local school districts. Even in these situations, doctoral programs can be enhanced with more geographically rich intentions.

The following charts and tables show the resident status of doctoral enrollment at all Texas public universities and health-related institutions (in fall of 2003). Statewide, 47 percent of doctoral students were Texas residents, 17 percent were from other states, and 36 percent were international students. These figures compare to 93 percent Texas residents, 3 percent out-of-state, and 4 percent international students for public baccalaureate education and 76 percent Texas residents, 7 percent out-of-state, and 17 percent international students for public master's programs.

Students at Texas Public Universities and Health-Related Institutions by Residence and Level, Fall 2003



THECB, 7/2004

Source: THECB CBM-001 Student Report, Fall 2003

	Fall 2003 Doctoral Enrollments			
Institution	In-State	Out-of-State	International	Grand Total
Lamar University	7	8	20	35
Prairie View A&M University	23	3	4	30
Sam Houston State University	80	41	30	151
Stephen F. Austin State University	51	4	0	55
Texas A&M University System Health Science Center	44	18	61	123
Tarleton State University	15	0	0	15
Texas A&M University-Corpus Christi	89	0	0	89
Texas A&M University	1,170	470	1,589	3,229
Texas A&M University-Commerce	255	17	7	279
Texas A&M University-Kingsville	113	6	45	164
Texas Southern University	131	6	4	141
Texas State University-San Marcos	87	14	12	113
Texas Tech University Health Sciences Center	69	29	28	126
Texas Tech University	644	196	463	1,303
Texas Woman's University	534	57	39	630
The University of Texas Southwestern Medical Center at Dallas	175	155	145	475
The University of Texas at Arlington	422	42	355	819
The University of Texas at Austin	1,728	1,491	1,969	5,188
The University of Texas at Dallas	279	48	429	756
The University of Texas at El Paso	143	34	83	260
The University of Texas at San Antonio	152	3	65	220
The University of Texas-Pan American	57	4	27	88
University of Houston	788	128	456	1,372
University of North Texas	830	159	327	1,316
University of North Texas Health Science Center	85	8	45	138
The University of Texas Health Science Center at Houston	368	146	182	696
The University of Texas Health Science Center at San Antonio	116	39	96	251
The University of Texas Medical Branch at Galveston	123	62	75	260
West Texas A&M University	1	2	0	3
Grand Total	8,579	3,190	6,556	18,325

Higher education in the U.S. is built upon the premise that while each state should educate its own people for in-state jobs, each state also has a responsibility to educate doctoral students for jobs outside the state and nation, for mutual benefit of all. Higher education in Texas reflects this premise and benefits from it. Only about one-fourth of doctorally prepared faculty at Texas public universities and health-related institutions received their degrees from Texas public institutions (as indicated in the institutions' 2003 catalogs). The University of Texas at Austin (UT) with 30 percent and Texas A&M University (TAMU) with 25 percent produced over half of these faculty. The University of Houston (10 percent), Texas Tech University (9 percent), the University of North Texas (8 percent) and Texas Woman's University (5 percent) have produced most of the rest.

Section IV: Costs and Benefits of Doctoral Education

Doctoral education is expensive, with significant costs that must be covered by Texas institutions, the state, and doctoral students themselves. However, all three of these affected groups receive considerable benefits from doctoral education. This section will examine the costs of doctoral education in Texas and identify its benefits, including some that are less obvious.

A. Costs to Students

While nearly half of all doctoral students across the U.S. receive assistantships (according to the Department of Education), the stipends these students receive do not generally cover the cost of living. Doctoral students who do not receive assistantships must find the financial support elsewhere. In 2002, the Council of Graduate Schools reported that 46 percent of doctoral students incur education-related debt that averages $36,300 at graduation. After completing a master's degree, Texas public university doctoral students take an average of 59 semester credit hours. If no waivers or financial aid is provided, this translates into an average direct student cost for Texas residents for tuition and institutional fees of about $20,500. This does not include other expenses such as laboratory fees, course fees, special departmental fees, or books.

Another impact on student costs is the length of time required to earn a doctorate. As indicated in Section III C, the median time to complete a doctoral degree is 7.6 years of enrollment past a bachelor's degree. This amount of time results in considerable costs to doctoral students for living expenses, tuition and fees, and forgone wages.

B. Costs of Doctoral Programs to Texas Public Universities and Health-Related Institutions

Coordinating Board staff used two different approaches to approximate average institutional costs for doctoral programs. The first approach examined the projected five-year costs for doctoral programs authorized by the Board between January 2000 and January 2004. Those 34 (at 32 universities and two health-related institutions) doctoral programs (only single PhD or EdD degrees, not combinations of master's plus doctoral degree) averaged $2,045,045 per degree in new costs incurred by the institution, with a range of $95,000 to $6,077,246 and a median of $1,614,500. The large range occurs primarily because of the variance in the capability of some institutions to utilize existing resources for new doctoral programs. For example, larger institutions could sometimes reallocate faculty. In addition, higher costs were associated with science and engineering programs.

The greater costs for science and engineering programs are often a result of expensive equipment, laboratories, and materials needed for these programs. Also, faculty costs (often a substantial portion of the five-year new cost total) are generally higher in these disciplines than in many other fields. In addition to new faculty costs, graduate assistantships represent a significant cost to universities and health-related

institutions in maintaining doctoral programs. Of the programs reviewed, graduate assistantships averaged $15,647 per year for half-time work. The range of these assistantships was $10,000 to $25,000 and the median was $15,000. As expected, higher paid assistantships were generally associated with science and engineering degrees.

A second approach examined the total operational costs of existing doctoral programs through a study conducted by the Coordinating Board's Division of Finance, Campus Planning, and Research. In this study, institutions provided the Coordinating Board with operational costs (including faculty salaries, student services, academic support, and department operations) disaggregated by level of instruction – baccalaureate, master's, and doctoral education. The 20 public universities that have doctoral programs in Texas spent a total of $564,444,480 to educate the 12,823 doctoral students (full-time equivalent or FTSE) in Fiscal Year 2002, for an average of $44,019 per FTSE. This compares to an average of $18,024 per FTSE for master's education and $8,430 for bachelor's education.

There are a number of reasons why doctoral education is so much more costly than baccalaureate and master's-level education. Doctoral-level classes on average are much smaller than baccalaureate classes and somewhat smaller than master's classes. Also, doctoral dissertation advisors and other faculty spend a considerable amount of time individually with their doctoral students as they mentor them through their programs. With this responsibility and the expectation to conduct research and publish the results of that research, doctoral faculty usually have a numerically lower classroom teaching load than other faculty. Although their research efforts benefit the institution and the state through the funds they generate (and in other ways), this increases the cost of doctoral education substantially. In addition, other resources (equipment, laboratories, and library holdings) raise the cost of doctoral education significantly. In short, doctoral programs are expensive because significant resources are needed to support a relatively small number of students.

A comprehensive cost study of doctoral-level education at health-related institutions in Texas has not yet been conducted, but such a study is planned to begin in the near future.

C. Costs of Doctoral Programs to the State

The sources of funding for doctoral programs fall under four general categories: grants/contracts, reallocation of existing resources, formula funds, and other funds (e.g., Permanent University Fund, Higher Education Assistance Fund, gifts and donations, etc.). In reviewing new doctoral programs approved in Texas public universities and health-related institutions from January 2000 to January 2004 (as indicated above), staff found that sources of funding for these new programs were spread somewhat equally over the four sources for the first five years of the programs. However, after the initial years of a doctoral program, institutions begin to rely more on grants and formula funding to support their doctoral programs.

Of particular concern to the state is the amount of formula funding allocated to Texas public institutions for doctoral programs as compared to total formula funding for all instructional levels. The following table shows, for each university with doctoral programs, the total amount of doctoral formula funding received for semester credit hours (SCH) earned in the 2002-2003 base year, as well as the overall amount (for all instruction) of formula funding. Statewide, doctoral SCH accounts for only 2.1 percent of the total SCH generated at universities (236,726 of 11,346,675), but those SCH

Formula Funding (Instruction & Operations) for Texas Public Universities for Semester Credit Hours (SCH) Earned in Base Year 2002-2003

	SCHs Doctoral Programs	SCH All Instruction	Percent of SCH Doctoral Instruction	I & O Funds Doctoral Only	I & O Funds All Instruction	Percent of Funding Doctoral Only
Angelo State	0	168,056	0	0	15,580,962	0
Lamar	697	243,689	0.3	625,432	26,271,719	2.4
Midwestern	0	154,244	0	0	14,227,476	0
Prairie View A&M	373	199,835	0.2	230,166	21,973,721	1.0
Sam Houston	3,452	347,763	1.0	1,902,450	33,963,456	5.6
Stephen F. Austin	775	315,892	.3	434,367	30,089,492	1.4
Sul Ross	0	51,211	0	0	5,138,907	0
Sul Ross-Rio Grande	0	19,179	0	0	2,229,664	0
Tarleton State	0	214,939	0	0	21,458,758	0
Texas A&M	51,282	1,166,717	4.4	41,654,821	188,065,446	22.2
Texas A&M-Commerce	3,293	197,644	1.7	1,688,097	26,277,895	6.4
Texas A&M-Corpus Christi	1,044	196,904	0.5	556,811	21,111,033	2.6
Texas A&M-Galveston	0	43,032	0	0	3,835,746	0
Texas A&M International	0	89,655	0	0	8,930,273	0
Texas A&M-Kingsville	2,497	170,079	1.5	1,568,966	19,637,358	8.0
Texas A&M-Texarkana	0	27,031	0	0	3,536,117	0
Texas Southern	1,433	254,472	0.6	828,917	28,513,548	2.9
Texas State U-San Marcos	1,113	649,895	0.2	628,101	64,274,146	1.0
Texas Tech	19,022	740,228	2.6	14,106,947	91,566,264	15.4
Texas Woman's	8,104	198,977	4.1	5,194,014	36,283,970	14.3
University of Houston	19,341	838,365	2.3	14,875,851	114,110,769	13.0
UH-Clear Lake	0	148,078	0	0	23,443,455	0
UH-Downtown	0	231,186	0	0	18,318,517	0
UH-Victoria	0	41,480	0	0	6,345,199	0
U of North Texas	17,953	742,474	2.4	12,339,510	89,887,272	13.7
UT-Arlington	9,519	552,121	1.7	7,635,410	$79,176,110	9.6
UT-Austin	78,020	1,340,328	5.8	58,894,568	211,018,844	27.9

	SCHs Doctoral Programs	SCH All Instruction	Percent of SCH Doctoral Instruction	I & O Funds Doctoral Only	I & O Funds All Instruction	Percent of Funding Doctoral Only
UT-Brownsville	0	65,069	0	0	7,324,457	0
UT-Dallas	11,939	297,578	4.0	9,979,122	54,121,525	18.4
UT-El Paso	3,261	412,771	0.8	2,761,707	44,580,109	6.2
UT-Pan American	1,011	376,689	0.3	641,472	37,217,502	1.7
UT-Permian Basin	0	61,102	0	0	6,301,926	0
UT-San Antonio	2,597	525,809	0.5	1,985,756	53,659,358	3.7
UT-Tyler	0	95,195	0	0	11,976,614	0
West Texas A&M	0	168,988	0	0	17,802,721	0
TOTAL	236,726	11,346,675		178,532,485	1,438,250,329	
AVERAGE			2.1%			12.4%

produced 12.4 percent of the total amount of formula funding earned by the universities ($178,532,485 of $1,438,250,329). The University of Texas at Austin had the highest percent of formula funding revenue earned by doctoral courses (nearly 28 percent). On a per SCH statewide basis for the 2002-2003 year, doctoral education was funded at an average of $754/SCH, master's level at $259/SCH, and bachelor's level at $90/SCH.

The formula funding system is structured to provide this kind of disproportionate support for doctoral courses in order to account for the higher costs of doctoral education. Therefore, within each discipline, doctoral courses are "weighted" higher than other levels of instruction. The formula system also differentiates among disciplines, as higher funding rates (across all levels) are given to some disciplines to reflect the higher costs associated with these fields. The range of formula funding for doctoral courses (3 SCH) varies from $1,529.81 for Teacher Education to $3,290.25 for Engineering. (Lower-division liberal arts baccalaureate courses are funded at the lowest level – $153.75 for 3 SCH.)

The next table shows the formula funding provided to Texas public health-related institutions for doctoral education in 2002-2003. Most doctoral programs at these institutions are in the area of biomedical sciences, but programs (PhD and DrPH) in public health, nursing, and allied health account for other areas of doctoral education.

Doctoral-Level Formula Funding for Health-Related Institutions in Texas in Fiscal Year 2002

	Biomed Sci	Nursing	Allied Health	Pub Health	TOTAL
Texas A&M US-HSC	$ 1,160,712	$ 0	$ 0	$ 8,548	$ 1,169,260
Texas Tech-HSC	$ 623,054	$ 5,024	$536,429	$ 0	$ 1,164,507
UTHSC-Houston	$ 4,681,613	$359,868	$ 70,641	$2,633,765	$ 7,745,887
UTHSC-San Antonio	$ 2,465,249	$241,796	$ 0	$ 0	$ 2,707,045
UTMB-Galveston	$ 2,849,531	$224,211	$ 0	$ 0	$ 3,073,742
U of North Texas HSC	$ 1,080,934	$ 0	$ 0	$ 666,752	$ 1,747,686
UTSMCD	$ 5,058,142	$ 0	$ 0	$ 0	$ 5,058,142
TOTAL	$17,929,235	$830,899	$607,070	$3,309,065	$22,676,269

As indicated in the table, the total amount of formula funding provided to these institutions for doctoral education was $22,676,269. This amount represents 5.4 percent of the total formula funding provided to health-related institutions for all instruction. The formula system for health-related institutions is somewhat different than the university system, but it has the same general effect of providing greater funding for increased levels of study.

D. Benefits to Doctoral Students

Doctoral graduates can expect to earn significantly higher incomes than master's and bachelor's graduates. According to the U.S. Census, over a lifetime, doctoral degree recipients earn $3,105,793, master's degree holders earn $2,127,947, and bachelor's degree graduates earn $1,838,432. On an annual basis, those holding doctorates earn an average of $99,880; master's degrees – $69,441; and bachelor's degrees – $60,662.

Another benefit to those who hold doctorates is low unemployment, particularly in science and engineering fields. The National Association of Colleges and Employers reported that the average overall unemployment rate in the U.S. for doctorate holders in 2000 was 0.8 percent and rose to only slightly more than 1 percent in 2001. As indicated in Section III F, some graduates who desire tenure-track faculty positions do not receive such positions. And not all doctoral graduates receive jobs that specifically utilize their doctoral-level training. However, this group as a whole maintains lower

unemployment rates than other sectors of the population. In addition, many doctorate holders enjoy job positions that are personally enriching and bring benefits to others (as indicated below).

E. Benefits to Institutions

Institutions may receive numerous benefits from doctoral programs. In addition to the higher per-semester-credit-hour funding discussed above, an important financial benefit comes through external grant funding awarded to institutions for research projects. Texas public universities garnered $581,313,811 from federal research and development funds in Fiscal Year 2003, while public health-related institutions obtained $639,417,162. By region in Texas, the bulk (93.9 percent) of research expenditures fall into four Texas regions: Central Texas ($826,256,887 – 38.0 percent); Gulf Coast ($676,565,623 – 31.1 percent); Metroplex ($378,056,503 – 17.4 percent); and South Texas ($161,429,874 – 7.4 percent). The influx of federal monies is used to pay for many things, among them graduate assistants, faculty salaries, equipment, materials, and supplies. In addition, most grants come with certain "indirect costs" as part of the grant. Institutions can use these monies (which can be a significant percentage of the direct costs awarded in the grant) to cover general maintenance and operation costs of the institution. Although master's programs (or even bachelor's programs) can and do receive federal grant money, principal investigators with access to doctoral-level students and a doctoral program's accompanying resources are more competitive in securing large federal research and development funds.

According to the National Science Foundation, Texas ranked third in total federal research and development expenditures for 2001, behind California and New York. Other top states (in descending order) were Maryland, Pennsylvania, Massachusetts, Illinois, North Carolina, Michigan, and Ohio. The top five disciplines across the U.S. (as in Texas) were life sciences ($11.1 billion), engineering ($2.8 billion), physical sciences ($2.0 billion), environmental science ($1.2 billion), and computer science ($0.6 billion).

Other benefits to institutions occur as faculty develop patents from their research, and these faculty (and often their institutions) receive monies from the application of intellectual property. (Intellectual property revenue received by Texas public universities and health-related institutions totaled more than $34 million in Fiscal Year 2002.) The Texas Office of Economic Development and Tourism indicated that in Fiscal Year 2003, the state generated 6,509 patents and ranked third in the nation, trailing California and New York. (In Fiscal Year 2001, Texas public universities and health-related institutions received 747 invention disclosures and 164 U.S. patents, executed 99 exclusive and 88 non-exclusive licensing agreements, and formed 31 start-up companies.) Faculty at research institutions help develop and support many patents, regardless of who holds them, and they train the scientists who work in industry. In addition, partnerships between doctoral institutions and private industry (e.g., the $300 million alliance between The University of Texas at Dallas and Texas Instruments) can be formed to provide a boost to new discoveries. Start-up industries and "spin offs" can also be created as a result of doctorally based research.

Less calculable benefits of doctoral education include the national prominence that strong doctoral programs can bring to institutions. Such prominence can attract strong faculty and students (including undergraduate and master's students) from all over the country and world. This prominence can also draw donations and gifts from alumni and industry.

F. Benefits to the State and Nation

Industry, government, academia (and society in general) benefit greatly from the expertise of doctorally trained graduates. Solving scientific and medical problems that benefit our nation and world often requires the research skills acquired through a doctoral education in these areas. Doctoral graduates in disciplines such as humanities, fine arts, and the social sciences contribute to our understanding of human nature and can enhance the cultural and social environment of our state and nation. Governmental functions can be greatly enhanced through the expertise of doctorally trained employees. And, of course, doctoral graduates serve as faculty at all sectors of higher education. The economy of the state and the U.S. is highly dependent on the success of industry, government, and academia. A stronger economy in Texas brings higher average salaries and larger tax revenues to the state. Therefore, providing these groups with an adequate doctorally trained workforce is a critical function of higher education.

Sections V and VI

The second part of this study will be presented at the October 2004 Board meeting. This part will examine the strengths and concerns of doctoral education *specific to Texas*. It will also provide recommendations for the state, Coordinating Board, and higher education institutions for enhancing the effectiveness of doctoral education.

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ADDITIONAL DATA SOURCES

Institutional Undergraduate and Graduate Catalogs

National Science Foundation

Texas Higher Education Coordinating Board

U.S. Census Bureau

U.S. Department of Education